AXIOM Innovations

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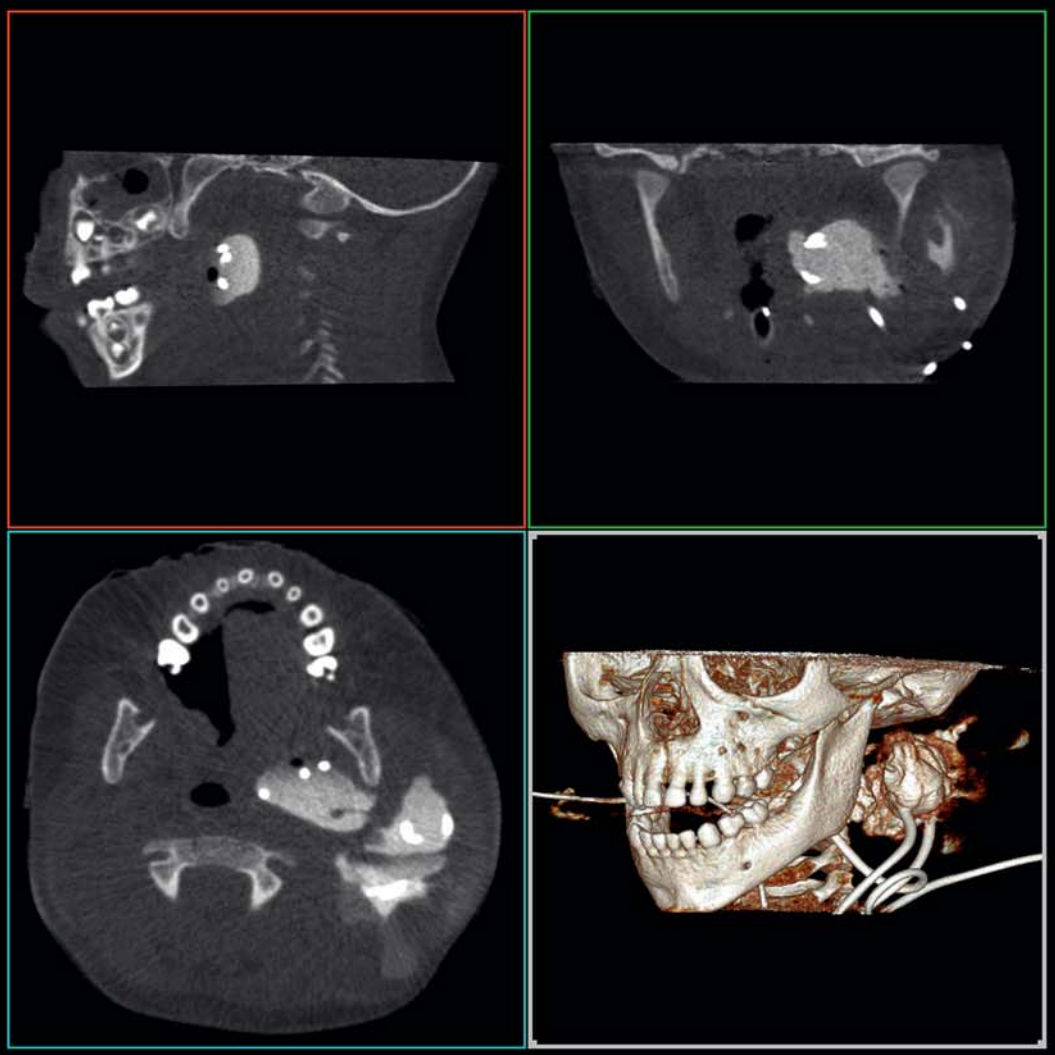
SIEMENS



Low Dose - High Principles

Saving Dose with CARE and *syngo* DynaCT

14

"Keeping image quality high and radiation dose low is one of the key drivers in the development of our imaging portfolio."

Dr. Heinrich Kolem,
CEO of the Angiography & Interventional X-Ray Business Unit (AX)
at Siemens Healthcare

Dear Reader,

Dr. Heinrich Kolem
CEO AX Division

Earlier this year, I had the opportunity to attend the Cardiovascular and Interventional Radiological Society of Europe's (CIRSE) annual conference in Munich. The CIRSE is one of the most renowned conferences for interventional imaging. There were approximately 6,000 attendees eager to learn about the latest technologies and advances in their clinical field. I was very pleased to see how many visitors were interested in our products and solutions. For the first time, we showcased how "The Future is Flexible" with the Artis zeego, our multi-axis C-arm system based on robotic technology. We introduced the Hybrid IR concept which offers new opportunities for interventional radiologists looking to expand to more complex cases. In order to meet current and future imaging needs, Artis zeego allows a variety of working heights and delivers large volume image results.

Improving clinical workflow and radiation dose reduction are of great importance to our customers and their patients. They are also key drivers for our development. We know that our customers carry a lot of responsibility for each individual patient they treat. In return, it is our responsibility to offer reliable systems to support our customers worldwide. We are constantly exploring new possibilities to reduce dose without compromising image quality. The title of this issue reflects that line of thought, "Low Dose - High Principles." Our dose saving initiative with CARE (Combined Applications to Reduce Exposure) and CLEAR (an imaging technology to enhance visualization with X-ray) not only reduces radiation dose for patients and staff, but also boosts image quality to an outstanding level.

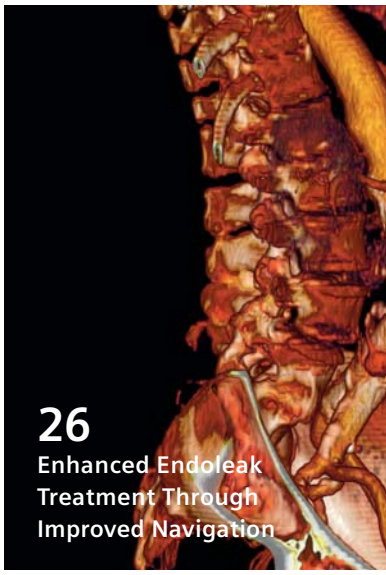
A growing trend in the market for interventional cardiology and hybrid surgery is the minimally invasive replacement of valves. With demographic changes in our society and a growing percentage of elderly patients, new treatment methods will evolve. Minimally invasive procedures are an exciting new treatment possibility especially for high-risk patients who cannot undergo open surgery. New innovative applications such as *syngo* Aortic ValveGuide* help surgeons and cardiologists replace calcified aortic heart valves with more guidance and a new automated workflow.

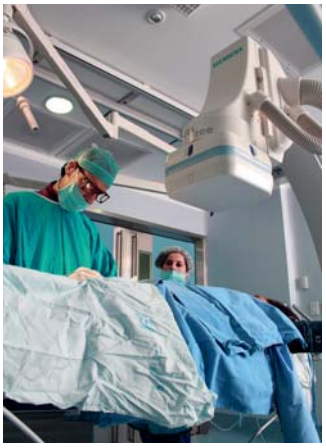
Looking back on a very exciting year for Siemens Healthcare, I am proud to present to you this issue of AXIOM Innovations. You can read more about CARE technology, new functionalities in endovascular and thoracic surgery, and many other innovative topics. Enjoy!

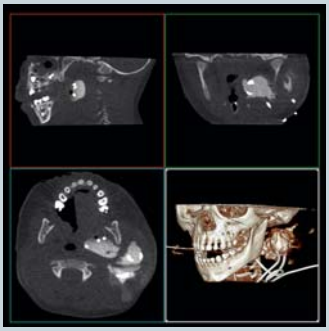
Dr. Heinrich Kolem

* The *syngo* Aortic ValveGuide is pending 510(k) clearance, and is not yet commercially available in the United States.

Content



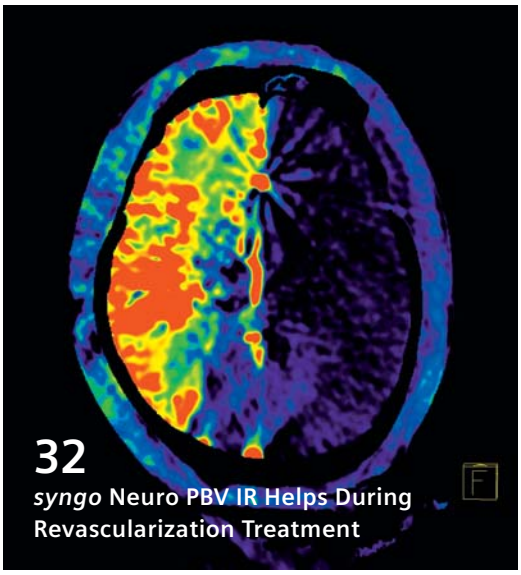




Cover

Imaging of temporal mandibular joint with reduced radiation dose.

Courtesy of Anne Marie Cahill, M.D., Department of Interventional Radiology, Children´s Hospital of Philadelphia, Pennsylvania, USA



Angiography

Cardiology

Surgery

Customer Care

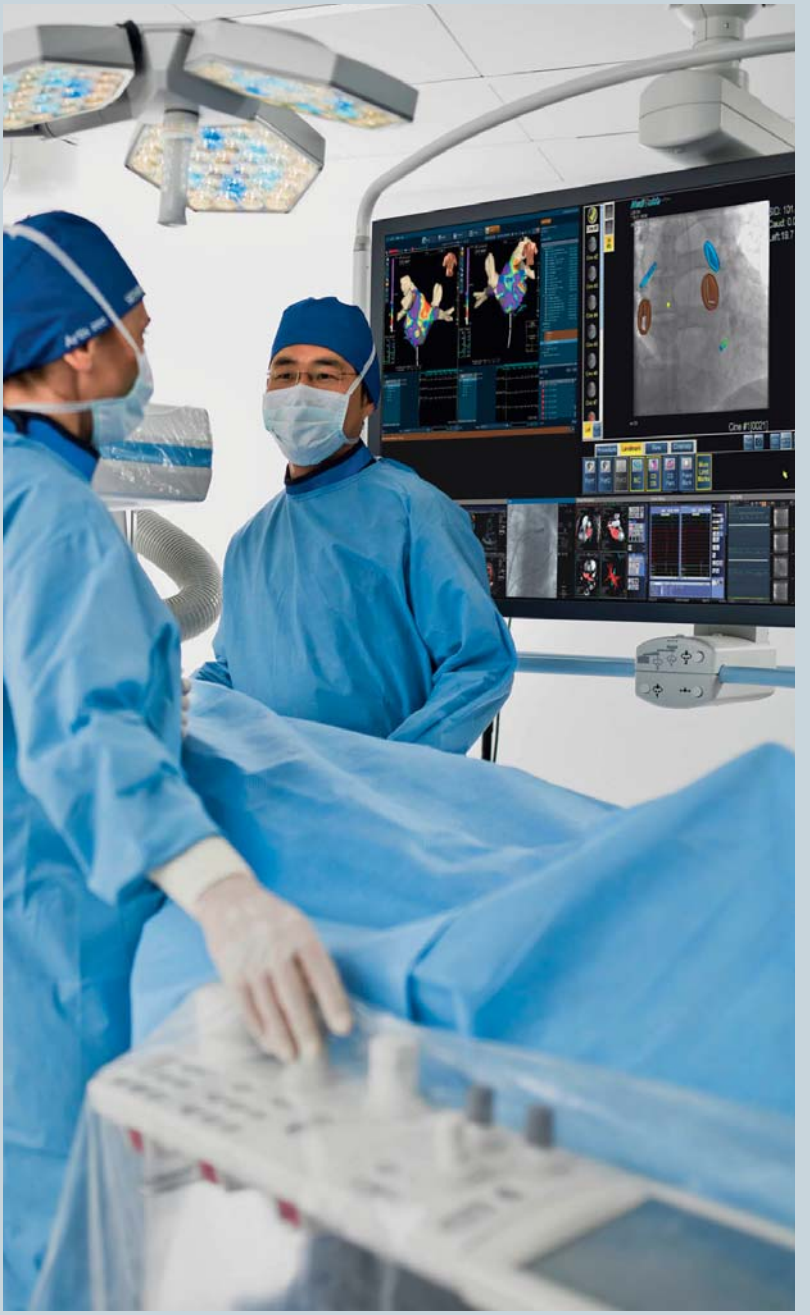
Less Radiation During Catheter Interventions

Siemens' Artis zee® angiography system has recently integrated the MediGuide Technology from St. Jude Medical, a medical positioning system that visualizes the position of a catheter without radiation.

Like a GPS system, the MediGuide Technology locates the catheter during cardiac interventions and projects its precise position in real time on a previously acquired fluoroscopy image of the patient. During electrophysiological interventions, a miniaturized sensor integrated into the catheter can be located by receiving electromagnetic positioning signals from the MediGuide transmitters, which are incorporated into the detector housing of the Artis zee system. The MediGuide Technology then calculates the respective position and orientation of the catheter and displays it in real time on fluoroscopic images of the patient that were recorded earlier. The technology also compensates for patient movement caused by respiration and heart motion.

The MediGuide Technology provides significant benefits especially during complex electrophysiological procedures. The electrophysiologist no longer has to take fluoroscopic images of the patient each time the catheter is re-positioned. As a result, less radiation and less contrast agent use is expected.

The Heart Center Leipzig, Germany, has already performed the first interventions with Artis zee and the MediGuide Technology. "The low-radiation, precise localization of the catheter tip onto the pre-recorded fluoroscopy image is a most impressive function, because the system is able to compensate the motion from the heart beat and breathing," said Professor Dr. Gerhard Hindricks, Director of the Rhythmology Department. "For my team and me, this is clearly the future in electrophysiology."



Localization of the catheter supported by MediGuide Technology and EnSite Velocity Mapping System.

Integrated FFR Calculation Saves Space and Time

The measurement of fractional flow reserve (FFR) helps to determine the hemodynamic significance of a coronary stenosis and to guide balloon and stent placement. FFR is being measured by comparing the blood pressures distal (behind) and proximal (in front) to a lesion. Once this ratio reaches 0.75 or below, a stenosis is considered hemodynamically significant and a stent placement is recommended.

The FAME study published in 2009 (N Engl J Med 2009; 360:213-224) evaluated FFR-guided CAD treatment and clearly found an increase in patient survival of 30 % while at the same time treatment costs decreased by 30 %.

St Jude Medical and Volcano offer FFR measurement solutions in the cath lab that now have been fully integrated with the Siemens AXIOM Sensis XP recording system, which offers simple plug&play connectivity and makes using an external workstation obsolete.

For getting the new FFR measurement capabilities, AXIOM Sensis XP software must be upgraded to the latest software version due for release at the end of 2011. The FFR option can already be ordered today and will become available with the new software version.

All systems in the field currently running software version VC10 will be upgraded free of charge to VC11 starting in spring 2012.

AXIOM Sensis XP running VC11 software and FFR option.

A New Era: Hybrid Operating Rooms in the American Hospital

Dr. Genco Yücel, Department of Cardiology, in front of the department's new Artis zeego.

As one of the most modern hospitals not only in Turkey but the entire region, the American Hospital in Istanbul continues its leading role in hybrid operating room practices with the recently installed Siemens Artis zeego multi-axis robotic angiography system. Thanks to the Artis zeego system, both advanced hybrid practices and standardized cardiologic procedures can be performed. In the new procedure room that has an angiography operating table that tilts in four different directions, a laminar flow unit and anesthesia device pendants, the latest technological innovations, such as a 56" Artis zee Large Display, an integrated Intravascular Ultrasound (IVUS), an integrated hemodynamic recording system (Siemens AXIOM Sensis XP), etc., are used. At the center where TAVI (Transcatheter Aortic Valve Implantation) procedures have recently begun to be performed with the use of the Artis zeego system and Siemens *syngo* DynaCT Cardiac software, procedures can be completed more rapidly and reliably with the comfort introduced by Artis zeego and the wide movement capability of the C-arm. The American Hospital is currently able to perform interventional procedures, thanks to the hybrid system it has recently acquired, as well as ongoing medical, technical and technological developments. Operating in Istanbul, Turkey since 1920, the American Hospital offers the latest technologies to aid the hundreds of millions of people in the region as a hospital held in high regard not only in Turkey but in neighboring countries as well.

Hybrid OR With Trumpf Table Opened at Clinical Center Ludwigsburg

Since 2010, Siemens optionally delivers Artis zeego or Artis zee ceiling with the TruSystem 7500 OR table by Trumpf. In May 2011 another hybrid operating room with Trumpf´s OR table and Siemens Artis zeego went live at the clinical center Ludwigsburg, Germany – meanwhile this is the sixth installation worldwide that combines an Artis system with a Trumpf OR table. The room at the clinical center Ludwigsburg is located in a brand new building as part of a 35 million euro project to build one of the most modern surgical centers in Germany with altogether 9 fully digital connected operating rooms. With this new hybrid OR, patients will benefit from fewer shifts during the procedures, less radiation because of faster and fewer acquisitions, and fewer complications since the success of the intervention can be verified right in the OR at the end of the procedure.
Siemens is also going to offer a similar integration of the Artis zeego and Artis zee ceiling with Maquet OR tables in early 2013.

View of the new hybrid operating room in Ludwigsburg with the Trumpf TruSystem 7500 OR table and Siemens Artis zeego.

Siemens Integrates Maquet's Magnus OR Table for Hybrid ORs

Fig. 1: Siemens Artis zeego with Maquet's Magnus table with breakable top supports complex procedures in advanced positions.

Fig. 2: Maquet also offers a radiolucent table top for artifact-free imaging in endovascular procedures.

The versatile Magnus OR table* from Maquet will be available together with Artis zeego and Artis zee ceiling. With the existing family of Artis tables, Trumpf's TruSystem 7500 tables and the Magnus table to follow, Siemens can provide three fully integrated table systems. This means synchronized C-arm and OR table movements, 2D and 3D imaging, all with a single integrated operation module. And the right table for surgical requirements in the hybrid OR.

The key benefit of the new solution is the multidisciplinary use of the hybrid OR – which means it will allow for both interventional imaging and for open procedures where extremely flexible patient positioning may be required. The Magnus OR table is fitted with exchangeable table tops – a fully radiolucent carbon top (Fig. 2) as well as a highly flexible, segmented table top (Fig. 1). The latter allows surgeons the most appropriate patient positioning, including complicated positions, occurring especially in orthopedics and neurosurgery. The Artis zeego is the only robotic C-arm-system on the market that can adapt to the complete height adjustment of the table. The multi-axis robotic system also follows the movements of the operating table. It flexibly adjusts to even complicated positions of the segmented table top. This flexibility also allows free access from any side, with a comfortable space for the anesthetist and his equipment. If open procedures without imaging equipment are performed, Artis zeego's multiple park positions allow for maximum space in the OR field.

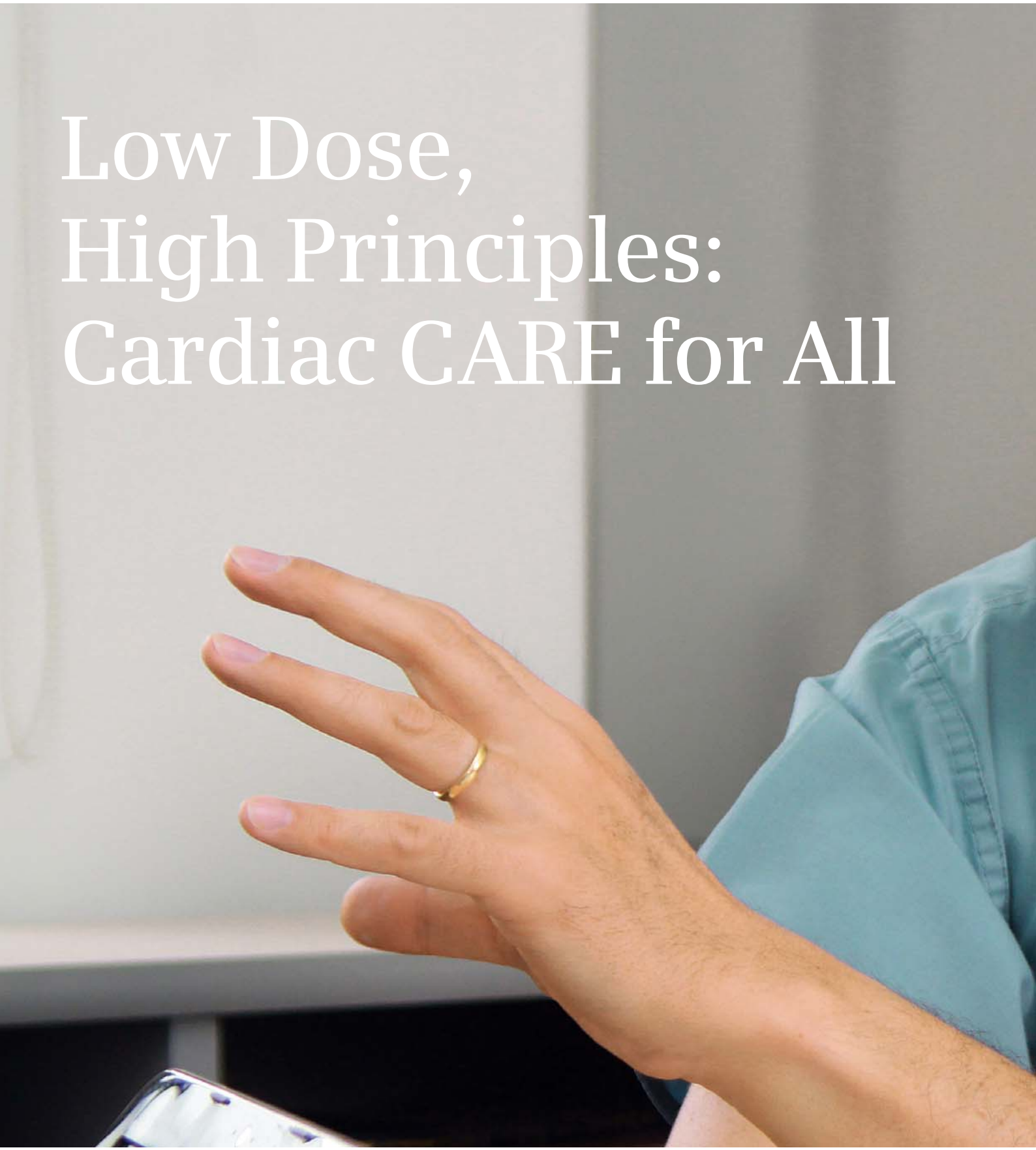
Equipped with an additional floating carbon table top, the integrated solution enables full cath lab functionality. The table top provides 360° radiotranslucency for superb X-ray images, including 3D. A transport system ensures the easy exchange of the table tops. The patient can be prepared and positioned on the table top in the induction area ensuring ahead of time maximum efficiency for the OR.

First clinical user tests of the integrated solution with Artis zeego are anticipated to start in May 2012; general availability is planned for December 2012. The integration with Artis zee ceiling is scheduled to be available in spring 2013.

Of course Siemens will continue to offer the tried-and-true family of fully integrated Artis zee tables. They are available in three different versions: the standard table, table with tilt, and the OR table with tilt and cradle. The carbon table tops allow for high-end imaging, including 3D. The Artis table family is the solution of choice for cardiac and vascular procedures providing an extensive longitudinal travel range, full body coverage and a free floating radiolucent table top.

* WIP. The information about this product is preliminary. The product is under development and not commercially available in the U.S., and its future availability cannot be ensured.

Low Dose, High Principles: Cardiac CARE for All



At Fundación Cardioinfantil in Bogotá, Colombia, no one is turned away for lack of ability to pay. Using the most advanced equipment from Siemens, the hospital's dedicated staff is making interventional imaging safer for everyone, especially those who need it most: their youngest, weakest patients.

By Chris Kraul

"The Siemens engineers have helped a lot in giving individual training to our personnel with the goal of minimizing the radiation used in a given exam and to devise additional measures of radiological protection."

Miguel Ronderos, M.D.,
Department of Cardiology, Fundación Cardioinfantil, Bogotá, Colombia

Any day now, Nelsy, a five-year-old Colombian girl, will undergo an angioplasty at Bogotá's Fundación Cardioinfantil hospital that will save her life. Pale, underweight and short of breath, Nelsy was screened in late May by the clinic's outreach team in the southwestern city of Pasto and found to have persistent ductus arteriosis, a congenital condition that, without a procedure to close the ductus, would have proved fatal by her mid-teens.

Nelsy, whose mother and ten-year old brother both died of heart disease, will be brought to Bogotá free of charge from her home 300 miles away, a poor fishing village on Colombia's southwestern Pacific coast. She and her father will be put up in the clinic's housing and, despite the fact that they have no way to pay the hospital bills, Nelsy will be given the kind of care that has made Fundación Cardioinfantil a private, nonprofit institution, a beacon of cardiovascular treatment in Latin America. The hospital draws paying patients from throughout the Caribbean and Central America, and from as far away as Florida and Peru. It also takes on scores of pro bono "social" cases per year, like Nelsy's, mainly from Colombia but it accepts desperately poor patients from Ecuador and Venezuela as well.

Making the Safety Factor a High Priority

The procedure in the hospital's heart catheterization lab to close the ductus will only take 45 minutes. But it will save Nelsy from probable death by pneumonia in the coming years and give her a good chance of leading a long, healthy life, says Miguel Ronderos, MD, a cardiologist who trained at University of Alabama-Birmingham and who was part of the outreach team that diagnosed Nelsy. He will also perform the angioplasty.

"We immediately classified Nelsy as a medical emergency, because she is in heart failure right now. But she is also what we call a social emergency, because her mother and brother have died and her father is worried that he will lose her as well," says Ronderos.

By coming to Fundación Cardioinfantil in Bogotá for treatment, Nelsy will receive another benefit that could be just as consequential to her long-term health. Her procedure will be performed using Siemens' state-of-the-art "low dose" interventional imaging technology. The hospital has four Siemens Artis systems that – with their advanced software and imaging innovations – can dramatically cut the radiation exposure of patients like Nelsy, compared with what they would have received a few years ago.

Each system is bundled with Siemens' proprietary CARE (Combined Applications to Reduce Exposure) applications that can help to decrease typical exposure in catheterization labs. It does that by providing a broad range of dose saving applications, enhanced monitoring and reporting of the radiation being generated and a flexibility of use that allows doctors at Fundacion Cardioinfantil to tailor treatment to a patient's specific age, weight and diagnosis.

"The advances that we are seeing in Siemens' imaging are allowing us to be more precise with our procedures with less risk of complications and failures," said Dr. Ronderos. Additionally he states the better the imaging, the less time he spends diagnosing the condition and placing coils, stents and heart valves. That reduces the patient's and the medical staff's exposure to radiation, he said. That lessened exposure is important for the operator as well as the patient. Medical staff who administer the procedures are concerned about their own risk as well.

Making angiography safer has been a Siemens objective since the company entered the medical equipment field in the early 1960s, and especially since a low dose application initiative was launched in 1994. Since then, the company has achieved a series of breakthroughs, all with the goal of

A Vision of Improved Healthcare Access

Fundación Cardioinfantil's history began in 1971 when two Colombian doctors, brothers Reinaldo and Camilo Cabrera, returned home from completing their medical training at the Texas Heart Institute in Houston determined to address the inequalities of their country's healthcare. High on their list of concerns was the incidence of congenital heart defects, affecting one in every 100 babies. In developed countries, such defects are easily diagnosed and treated, but they too often proved to be death sentences in Colombia. Poverty and difficult geography make access to quality medical care an impossible dream for much of the population.

With the help of ex-president Carlos Lleras Restrepo, the new physicians opened the predecessor of today's foundation in a corner of Bogotá's Misericordia Hospital, a charity clinic for children, specifically to offer cardiovascular care to poor youth in the urban area. They relied on donations of services, equipment, cash and eventually land from the city of Bogotá, where the current 300-bed hospital is situated.

As it grew, the clinic broadened its mission to include children who could pay for treatment as part of a scheme by which paying patients helped subsidize care for the poor. Later, as the clinic's reputation for quality care spread, adult heart patients were admitted, also to help subsidize treatment for poor children. Adults now comprise about 70 percent of the caseload.

In 1986, the Cabrera brothers decided to provide care to young patients for whom a trip to Bogotá for life-saving treatment was impossible. The hospital began organizing outreach brigades – teams of a half-dozen doctors and nurses – to seek out sick children in remote, poverty-stricken areas of the country. Now, about eight times a year, the brigades hold two-day cardiovascular clinics at partner hospitals from one end of the country to the other where young patients in need gather. Two months prior to each visit, the foundation's community relations department starts getting the word out via radio announcements and posters that any family who has a child with possible heart problems will be examined for free. It was in one such brigade visit held at Pasto's Hospital Los Angeles in May that Ronderos diagnosed Nelsy, one of 400 young people who lined up for an examination, and put her on the list of kids to be brought to Bogotá. She and her father traveled eight hours by boat and four hours by bus to get to the examination site.

Fundación Cardioinfantil's staff examine about 4,000 poor young people per year during these outreach clinics. Of those, 250 children and adolescents, or about 20 percent of all the children examined, are subsequently brought to the hospital for heart surgery or angiography at the bustling Bogotá hospital, free of charge.

For their service to Colombia, the Cabrera brothers were decorated in July 2010 by then-president Alvaro Uribe with the Order of Boyaca, the highest national honor attainable by a Colombian civilian. One of the doctors, Reinaldo Cabrera, died in November 2010, but his brother Camilo continues to be active and currently is the director of the foundation.

Combined Applications to Reduce Exposure: An Integrated Answer to Dose Reduction

CAREvision: pulsed fluoroscopy application that provides extremely low frequencies to meet individual dose-saving targets. Pulses can drop from a range of 30 p/s to only 0.5 p/s. At 7.5 p/s, a 75 % dose reduction is achieved.

CAREfilter: a variable CU-filter (0.1 mm – 0.9 mm) is automatically set according to the current transparency of the object/C-arm angulation, without any necessary interaction from the user. Dose reduction: up to 50 %.

CAREposition: positioning without repeated fluoroscopy. The feature is especially needed during long-lasting neurointerventions that can take several hours as the provider can control patient positioning without the need for additional fluoroscopy.

CAREprofile: radiation-free adjustment of collimators as well as radiation-free semitransparent filter parameter setting. Dose reduction: Up to 9 %.

CAREguard: a new real-time application that monitors skin dose exposure and allows for effective skin dose control. Three separate thresholds can be defined with warning indicators that alert for length of exposure time. The feature reduces exposure for radiologists, technicians, and patients.

Low Dose Acquisition: additional low dose protocols that can be accessed hands free, directly from a footswitch. These tools can reduce radiation dose by 67 %.

Low Dose *syngo* DynaCT: an optional feature, offers CT-like 3D imaging for radiosensitive patients and others. As an example, 5 sec protocol can be done at 0.1 µGy/frame instead of 0.36 µGy/frame, which results in a 72 % reduction.

CAREreport: a structured dose report that contains all patient demographics, procedure, and dose information. Using commercially available programs or in-house software, this information can be filtered for further processing, such as dose analysis.

limiting dosage while enhancing image quality. Improved safety is doubly critical because of the expanding range of diagnoses and treatments for which angiography is now used, going far beyond its original cardiovascular application to include neuro and abdominal interventions and surgeries.

The low dose equipment is achieving that goal with a variety of innovations. Proprietary technology pulses radiation instead of emitting continuous fluoroscopy. With CAREvision, high quality images are now captured at 7.5 frames per second, down from 30 frames previously, making possible a 75 percent reduction in radiation during the procedure. CAREreport offers a running account of radiation dispersed along with the patient's demographics, procedure and dose information.

A Two-Way Flow of Information

But there is more than that to low dose. Efficiency gains from powerful new Siemens software have improved the imaging and visibility of devices. Over the last five years, Siemens *syngo* DynaCT has made soft tissue imaging possible, enabling physicians to get additional soft tissue information in the interventional suite and thus get a better understanding of the structure of the vessels and organs they are dealing with.

Dr. Dario Echeverri, who heads Fundacion Cardioinfantil's catheterization lab and who is also the current president of the Latin American Society of Interventionist Cardiology, said the CARE application "CAREguard" is especially valuable because it tracks radiation skin dose thresholds of patients and medical staff and sounds a warning if they are exceeded.

"It allows us to do a continuous follow-up of the radiation dispersed by the machines and helps us reduce exposure to patients and MDs, nurses and technicians working in the lab," Echeverri said.

Cognizant of the importance of low dose imaging, Siemens sends a free update of the latest software VC14 including all CARE (Combined Applications to Reduce Exposure) and CLEAR (image quality) features to all customers of its Artis zee angiography systems around the world.

Siemens' advances now enable doctors to reduce the number of times a typical heart patient has to undergo imaging exams. A decade ago, Nelsy might have had to undergo three different procedures during her stay at Cardioinfantil: one to diagnose, a second to treat her disease, and a third to confirm success. But the likelihood now is that a single procedure will suffice.

"Nowadays, we must be much more careful with our exams in arriving at a diagnosis," Dr. Ronderos said. "Each day we are more aware of the importance to health of the cumulative dose of radiation over the course of a lifetime and, with the Siemens technology we have, combined with our understanding and quality of the imaging, we can minimize exposure in a given exam."

Fewer procedures also mean a patient receives fewer injections of contrast agent, which if overused can damage kidneys.

As one of a dozen Siemens "reference sites" at leading hospitals in Latin America and the Caribbean, Fundación Cardioinfantil has become a key proving ground for Siemens' low dose imaging initiative in the region. The clinic also has become an incubator for more intensive relationships between Siemens product managers and the medical professionals who use the company's equipment. The company and its clinical customers see such close relationships as a necessity, given the high stakes in cardiovascular care: the life-saving benefits of cutting-edge therapies as well as the potential hazards of the imaging devices.

"Over the last year, a real two-way flow of information with Siemens has begun, so that we can receive not just the low dose technology but training and advice, and we want that to continue," says cardiologist Echeverri. "By the same token, we offer suggestions on design improvements to better protect the patients and people who work in the room." Those suggestions have included smaller tables to accommodate child patients and design changes for protective clothing.

The advances of the Artis zee system give Dr. Echeverri added flexibility in devising different protocols "according to the patient and his or her condition, instead of using the same program for all patients. This is new with the latest software of our Artis zee." Adds Dr. Ronderos: "The Siemens engineers have helped a lot in giving individual training to our personnel with the goal of minimizing the radiation used in a given exam and to devise additional measures of radiological protection."

In February, Siemens brought in experts to the clinic from Germany to lead a dose and radiation workshop on safe operation of the angiography systems. That was an important gesture, says Echeverri, because he, Ronderos and other medical staff operate the machines themselves without specially trained technicians.

"We want the relationship with Siemens to go far beyond buying and selling equipment. We want Siemens to help us in an integral way with training, marketing and advice, a friend who will help distinguish the foundation. The Low Dose Workshop with Siemens was very encouraging, and it produced concrete results," says Echeverri.

In exchange for going the extra mile, Siemens is allowed to bring prospective clients to Cardioinfantil to see the systems in action, and even bring in doctors and nurses from foreign countries to receive training on the machines. Siemens also gets important feedback that is incorporated into the systems' software and design. A bonus for Siemens is its association with one of Colombia's most admired institutions for its mission of delivering lifesaving cardiovascular care to poor children and young people who otherwise might die prematurely.

Attesting to Fundación Cardioinfantil's high standards is its cooperation arrangement with the Cleveland Clinic, which sends medical staff to Bogotá once a year to conduct professional seminars.

"Most companies just want to sell machines and there is usually a disconnect between the sales and technical staff of these companies. Siemens is changing that trend. Together we are constantly refining the proper use of the machines," Dr. Ronderos concluded. "We have come to a nice arrangement."

Chris Kraul is a freelance writer based in Bogotá, Colombia, covering stories a wide range of topics. A reporter for the Los Angeles Times for 22 years, he was most recently the Latin American Bureau Chief at the newspaper's Bogotá office.

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"CAREguard allows us to do continuous follow-up of the radiation dispersed by the machines and helps us reduce exposure to patients and MDs, nurses and technicians working in the lab."

Dario Echeverri, M.D.,
Department of Cardiology, Fundación Cardioinfantil, Bogotá, Colombia

A Pediatric Radiologist's Approach to Radiation Reduction

Siemens has long been a leader in addressing the need to provide optimal images at the lowest possible radiation dose. AXIOM Innovations' Robert L. Bard discussed radiation dose savings and their clinical application in pediatric patients with Anne Marie Cahill, MD, of the Children's Hospital of Philadelphia.

By Robert L. Bard

There is considerable concern among both medical professionals and the public these days about radiation exposure, in part due to the growing use of imaging equipment in both diagnostic and interventional medicine. Anne Marie Cahill, MD, Director of Interventional Radiology at the Children's Hospital of Philadelphia, has worked with the Siemens' product development group to find new ways of imaging with lower radiation doses and at the same time achieving the best possible images. This principle is commonly referred to as the "ALARA" principle: as low as reasonably achievable.

While clinicians must be aware of acute radiation exposure from any individual procedure, they must be even more diligent in managing chronic radiation doses for their patients who receive either multiple procedures acutely or chronic procedures in a long-term evaluation of their condition. These concerns are paramount for Cahill because she frequently deals with complex cases. Furthermore, radiation exposure is especially important for her because she is treating children.

Siemens products have long been designed to help clinicians obtain quality images while following the ALARA principle. Siemens addresses the ALARA principle with its Combined Applications to Reduce Exposure, or "CARE" package. CARE is available throughout the Siemens line of imaging products and addresses several aspects of the imaging process, including the documentation and monitoring of radiation exposure of both patients and clinicians. A primary feature of CARE is the ability to standardize radiation doses at the lowest possible level for each and every procedure or image. CARE permits the interventional radiologist to choose programs in advance so that ALARA can be achieved. Study-specific imaging programs automatically using the lowest possible radiation dose while providing the best possible images, but clinicians still have the ability to increase the dose if there is an area of interest that requires further investigation. For example, Cahill commonly evaluates patients with vascular anomalies where she first selects a low dose 3D program, *syngo* DynaCT, to deliver the lowest necessary dose of radiation to image the vasculature. However, if she notices a section of blood vessel that is not imaged well or appears to be abnormal during the initial scan, she has the freedom and ability to interrupt the standardized program and she can concentrate the imaging on that particular area and investigate any potential abnormalities.

Siemens CAREguard is available with all Artis zee angiography systems, providing skin dose control software that helps limit and document radiation levels. With CAREguard, radiation

doses are constantly measured and the user can set the parameters to site-specific values. If pre-defined skin dose levels are exceeded, an audible warning sounds, and a skin dose indicator flashes on the live display. A warning pop-up is also prominently displayed on the touchscreen of the system's table-side control, which is located within the interventional radiologist's view during the procedure. Radiation exposure levels can be generated with CAREreport, and they can also be archived in the PACS system along with the procedural images. Cahill and her colleagues regularly take advantage of this feature by providing patients with radiation information when reviewing clinical results.

Clinical Applications for Low-Dose Imaging

Cahill has worked closely with Siemens in developing C-arm CT protocols that provide 3D information in the interventional radiation suite at very low radiation doses. She reports that she has experienced three major benefits of the Siemens products in their ability to image at the lowest possible radiation doses: Store Fluoro, Overlay Reference, and Low Dose *syngo* DynaCT.

Store Fluoro enables the user to store a regular fluoro scene during a procedure for documentation instead of doing a new acquisition. Cahill explains that this functionality allows her to decrease the number of acquisitions she requires as compared to previous clinical methods. She can save images on the display monitor instead of obtaining further images and exposing the patient – and staff – to additional levels of radiation. Prior to having this capability, it would have been necessary for her to acquire additional images to assure she had all of the information she needed before the patient left the interventional radiology suite.

Similar to Store Fluoro, Overlay Reference can decrease the number of images acquired as compared to previous clinical imaging methods. Not only are fewer images necessary using Overlay Reference, but the images are obtained at a lower radiation level. Therefore, radiation is decreased as compared to traditional applications that relied upon traditional fluoroscopy. During common vascular imaging, radiation dose is decreased because, as Cahill states, "We can do an angiogram and save a specific image and then overlay that image onto the live fluoro. Later that image can be used to track smaller arteries. This process saves radiation because we do not perform roadmaps (comprehensive tracking of blood flow through the vasculature) as much as we used to."

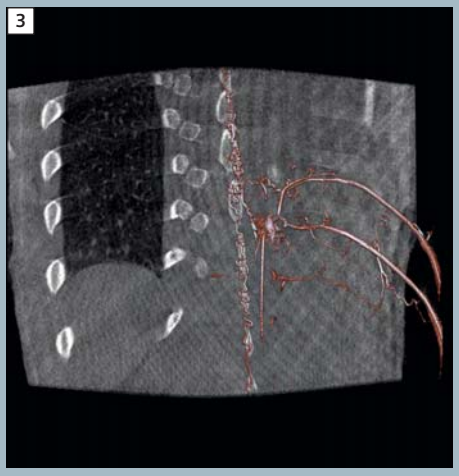
C-arm CT and Joint Injections

The Children's Hospital of Philadelphia also uses *syngo* DynaCT to reduce radiation exposure in patients who require imaging where the radiation dose is a particular concern. C-arm computed tomography permits joint injections with the use of CT and fluoroscopy and

AVM nidus extending from T6 to L1 supplied by a left intercostal artery

1 Conventional intercostal artery angiogram

2 VRT (Volume Rendering Technique)



3 Embedded MPR Image of AVM nidus

omits an additional dose of radiation from traditional CT. Cahill references her research using C-arm CT, which shows that radiation doses can be significantly decreased when treating and evaluating patients with temporal mandibular joint (TMJ) disorder. She explains that radiation savings are largely obtained by reducing the need to acquire traditional computed tomography examinations following interventional treatments. TMJ disorder commonly requires patients to receive repeated injections once or twice a year, and the radiation dose savings adds up during the course of treatment. Pediatric TMJ patients are one specific group where imaging with the ALARA principle is crucial because of the repeated radiation exposure of a vulnerable area, the jaw, because of its proximity to the eyes and thyroid.

Joint injections are a common application of C-arm CT because of the ability to image at very low dose. Dr. Cahill estimates based on phantom studies about a 50 percent reduction when compared to conventional CT and a further radiation dose reduction of 6% from a manufacturer setting. This dose reduction is possible due to the inherent high contrast of bone and needle in CT imaging. The benefit of such a significant dose savings also applies to the treatment of children with juvenile arthritis, who are sometimes as young as two or three years old and, as in TMJ cases, require multiple injections during the course of their treatment. The importance of reducing the amount of acute and chronic radiation is quite evident in these delicate patients.

Other areas where significant radiation savings are achieved include procedures where *syngo* DynaCT is used to guide the needle during bone biopsies and to assess the airway and lesion during vascular malformation therapy, whereby the intermittent imaging used in the latter is used to determine the relationship of the airway to the treated lesion to help decide if the patient's breathing tube can be safely removed post procedure. In vascular malformation therapy this helps clinicians determine whether the breathing tube can be safely removed from patients who are asleep under general anesthesia.

In addition, vascular anomalies are treated using Low Dose *syngo* DynaCT as well, and the radiation savings – also about 50 percent of conventional CT – is largely obtained once again by omitting a post-procedural traditional CT. One of the major advantages of treating vascular anomalies in this fashion is that the success of the sclerotherapy procedure can be evaluated immediately after the procedure by the same interventional radiologist at the same location, which is an efficient use of hospital resources and an excellent means to improve patient satisfaction to their clinical care.

The importance of dose savings – especially in young patients – will only increase with the growth of non-invasive imaging and radiologic interventions. Siemens has addressed the need to provide high-quality images at the lowest possible radiation dose with its CARE package, which provides a clear indication of the radiation levels used for every image or procedure. This ALARA approach improves the accountability of the interventional radiologist, interventional cardiologist, and administrators while promoting a healthy environment for patients and staff.

Robert L. Bard is a freelance medical writer certified by the American Medical Writer's Association who also conducts clinical research at the University of Michigan's Division of Cardiovascular Medicine.

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"Store Fluoro allows us to decrease the number of acquired images. With the Store Fluoro functionality we can save images on the display monitor instead of obtaining further images and exposing the patient, and staff, to additional levels of radiation."

Anne Marie Cahill, M.D., Department of Interventional Radiology, Children's Hospital of Philadelphia, PA, USA

Treatment of Complex Head and Neck Lymphatic Malformation in an Infant Supported by *syngo* DynaCT

Courtesy of Anne Marie Cahill, M.D., Deddeh Ballah, B.A.
Department of Interventional Radiology, Children's Hospital of Philadelphia, PA, USA

Children's Hospital of Philadelphia – Founded in 1855 as the nation's first hospital devoted exclusively to caring for children, it has been the birthplace of many firsts in pediatric medicine. In interventional radiology employees are working hand in hand to provide best possible care for their patients.

Patient history

At 40 weeks in utero the male fetus was diagnosed with a large neck mass on prenatal ultrasound. Prenatal MR imaging was performed demonstrating a 5.7 cm by 2.7 cm left neck mass. The patient was delivered at CHOP via Caesarean section for concern of airway compromise. The baby boy required routine resuscitation and was transferred uneventfully to the neonatal intensive care unit.

Diagnosis

On the third day of life, a neck MRI with and without gadolinium contrast was performed on the neonate, showing a T2 hyperintense, multicystic lesion with evidence of hemorrhage that extended to the posterior neck and deeper structures of the neck, including the prevertebral and retropharyngeal space, confirming a macrocystic lymphatic malformation.

Treatment

This patient underwent three doxycycline sclerotherapy procedures over the course of 24 months. Doxycycline is an antibiotic that causes inflammation of the lymphatic malformation epithelium that eventually leads to scarring and regression of the lesion. The second and third sclerotherapy procedures used Low Dose *syngo* DynaCT imaging to confirm sclerotherapy distribution in the lesion. The *syngo* DynaCT was acquired with a dose value of 0.7 mGy.

Comments

syngo DynaCT is used to confirm sclerotherapy agent distribution and determine proximity to the airway in patients with complex head and neck lymphatic malformations. Intraprocedural *syngo* DynaCT images can provide information regarding the volume of lesion treated and the necessity for further treatment sessions. It enables us to create image reconstructions in three planes on a separate workstation allowing us to compare the extent of the lesion treated to the pre-treatment lesion in those three planes on MRI.
Since this is essentially a CT scan it is imperative to achieve the lowest possible dose while preserving diagnostic information. With the inherent contrast provided by the sclerotherapy agent we are able to reduce the dose provided by our typical *syngo* DynaCT to 6 % of the manufacturer setting and 50 % of conventional CT.
In the future, *syngo* DynaCT can be used to direct procedures. By identifying areas of the lesions that lack sclerotherapy agent after injection, additional injections may be performed during treatment potentially reducing the number of future sessions.

Pediatr Radiol. 2011 Apr;41(4): 476-82. Epub 2010 Nov 16.

Results:
The manufacturer's default setting gave an equivalent CTDI of 4.8 mGy. Optimizing the dose settings and adding copper filtration reduced the radiation dose by 94 %. This represents a 50 % reduction from conventional CT.

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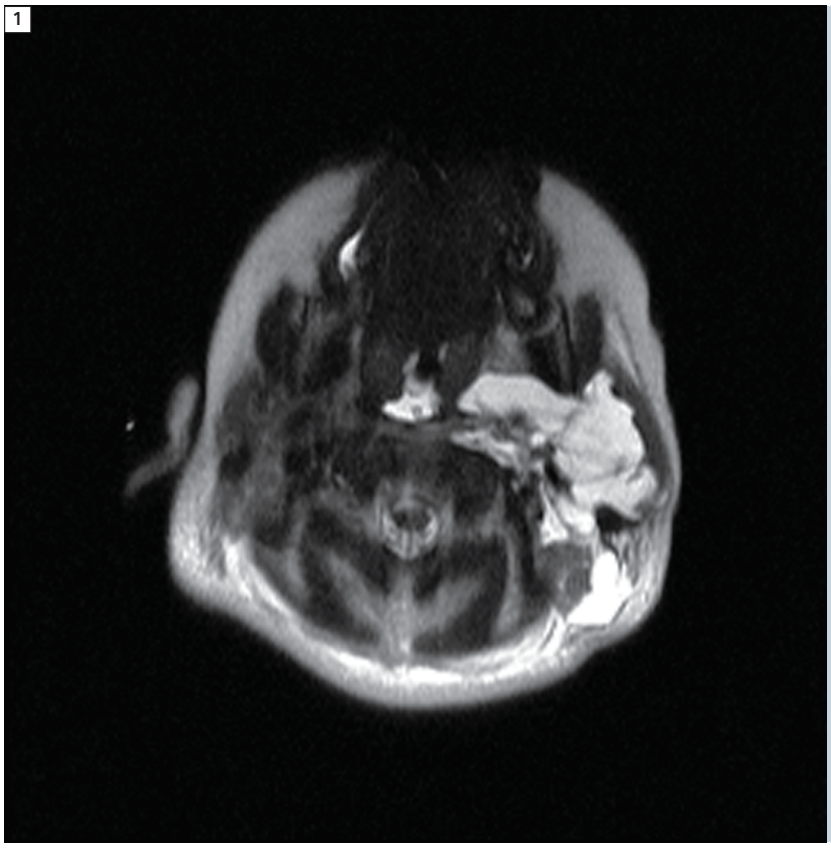


1 Axial T2 weighted MR image demonstrating the macrocystic lymphatic malformation left neck.

2 Correlating axial *syngo* DynaCT image demonstrating the distribution of the sclerotherapy agent throughout the lesion when compared to the MRI. Note the close proximity of the sclerotherapy agent and lesion to the airway guiding post-procedure therapy, resulting in the patient remaining intubated post-procedure.

Evaluation of CAREposition: Radiation-Free Positioning with CAREposition Results in a Decrease in Screening Times

Brendan Erskine, and Elissa Marshall from the Department of Radiology, The Alfred, Melbourne, Australia have conducted a study on the potential of CAREposition to reduce the fluoroscopic screening time during various diagnostic procedures. The study was presented as a paper: "Evaluation of Siemens CAREposition, Radiation-Free Positioning For Angiography and Fluoroscopy" at the ASMIRRT 2011 conference.

by Brendan Erskine and Elissa Marshall

Introduction

CAREposition is a Siemens functionality that enables accurate repositioning of the patient under visual control without radiation exposure. Guidance is provided by a centrally positioned crosshair marking the central beam while the collimated field of view (FOV) is visually displayed as a white outlined rectangular box. This is displayed on the last image hold and adjusts automatically to changes in position of the table and C-arm as well as changes in FOV.

Background

CAREposition functionality is aimed purely at reducing fluoroscopic screening time and therefore the primary focus of this study was to quantify these savings, not to investigate dose minimization. While a reduction in screening time will result in lower patient dose, ultimately dose is a product of many factors, beyond the scope of this study, such as:

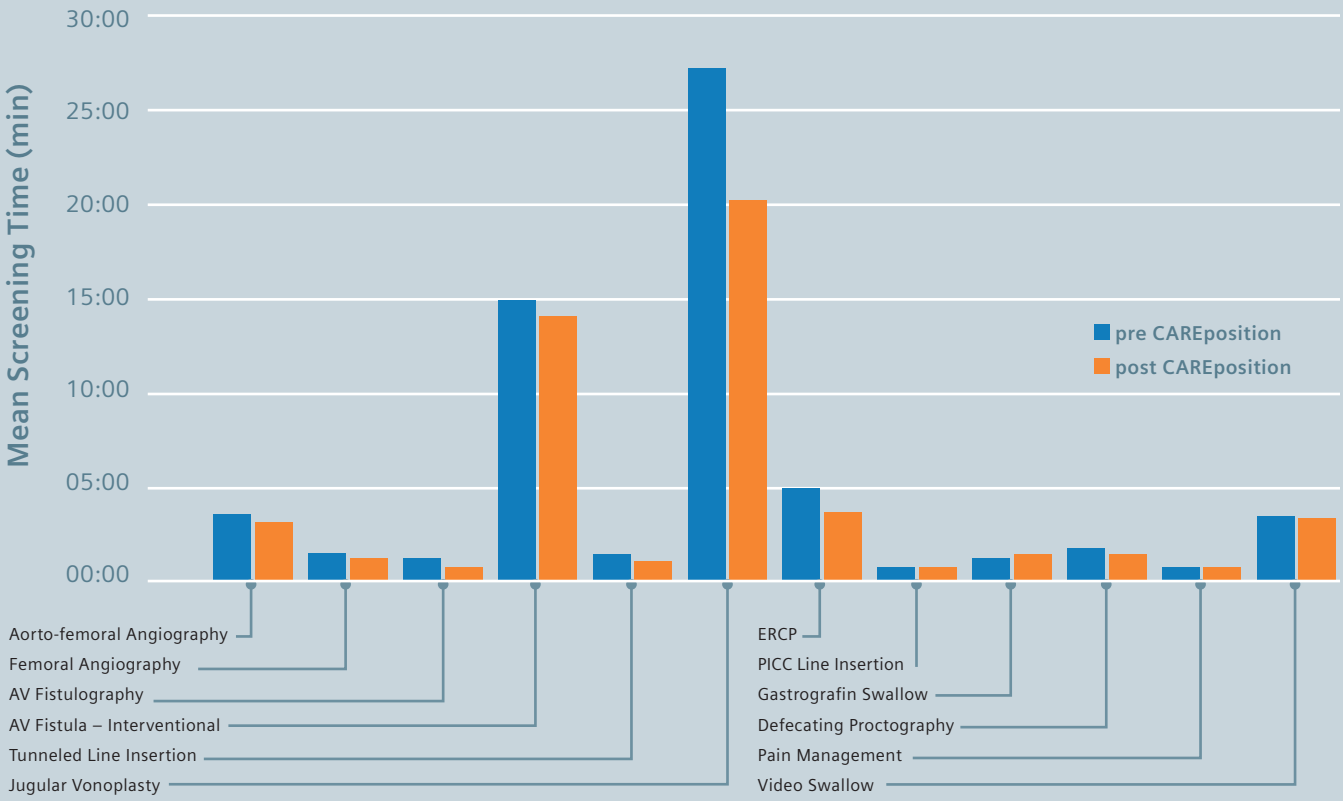
- Patient habitus
- Object-to-image distance
- Source-to-object distance
- Field of view
- Exposure factors (kV, mA)
- Exposure time
- Detector quantum efficiency (DQE)
- Pulsed fluoroscopy
- Adaptive dose filtration by the application of copper/aluminum prefiltration

Other techniques for reducing screening time,

- Last Image Hold (LIH) holds the last fluoroscopic image on the viewing monitor and incorporates radiation-free collimation and wedge filter placement

- 'Fluoro Store' or 'Fluoro Loop' permit the operator to review and save the last fluoroscopic imaging sequence. While not directly reducing the screening time, this software functionality may indirectly reduce screening time and patient dose by allowing the storage of fluoroscopic sequences instead of formal (higher dose) angiographic sequences

Table 1: Screening Times Pre & Post CAREposition



Erskine Brendan and Marshall Elissa, Dept. of Radiology, The Alfred, Melbourne, Australia

- Some fluoroscopic systems especially mobile image intensifiers (I.I.) incorporate the use of I.I. mounted laser guidance to assist positioning without the need for radiation. This relatively cheap method of image guidance suffers from many drawbacks such as the difficulty of laser visualization in brightly lit rooms and refraction of the laser through plastic I.I. covers. Also, accurate positioning of the laser is made more difficult on heavily draped patients.

Methods

Screening times from procedures performed on all angiographic and fluoroscopic machines were obtained over a six month period. At the trial midpoint, three multipurpose fluoroscopic/angiographic machines were enabled with

Table 2: Screening time measurements during diagnostic and interventional procedures

Procedure	Case Numbers	PRE CAREposition	POST CAREposition
Endoscopic retrograde pancreato-cholangiography (ERCP)	94	04:52	03:42
Gastrografin Swallow	65	01:18	01:24
Video Swallow	50	03:24	03:20
Defecating proctography	39	01:46	01:27
Peripherally Inserted Central Catheter (PICC)	656	00:45	00:45
Tunnelled catheter insertion (Hickmans, Permcath, Portocath)	103	01:28	01:00
Pain management injections (Epidural, Facet joint, Medial branch block)	126	00:47	00:47
Aorto-femoral angiography – Diagnostic	27	03:26	03:11
Femoral angiography – Diagnostic	25	01:30	01:11
Arterio-venous (AV) fistulography – Diagnostic	19	01:06	00:49
Arterio-venous (AV) fistulography – Interventional	22	14:50	14:02
Jugular venoplasty – Interventional	47	27:09	20:11

Erskine Brendan and Marshall Elissa, Dept. of Radiology, The Alfred, Melbourne, Australia

CAREposition software licensing:

- Siemens AXIOM Artis MP (fluoroscopy)
- Siemens AXIOM Artis MP (angiography)
- Siemens AXIOM Artis dMP (fluoroscopy/angiography)

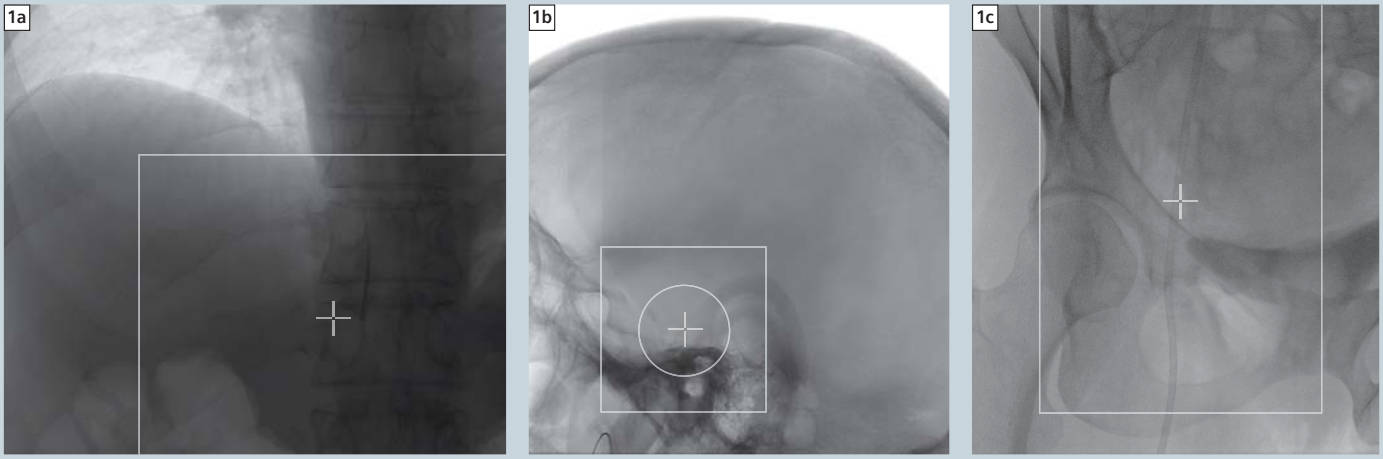
All machines employed remote (pedestal) C-arm/table controls ran exclusively by the radiographer. Our main angiographic machine, a Siemens Artis zee biplane, had CAREposition licensing from installation and was therefore excluded from the trial.
Although data from approximately 2,200 procedures were obtained, the variability of fluoroscopic and angiographic procedures (particularly interventional) will always lead to a wide spread of results. To obtain the most accurate data, only procedures (diagnostic or interventional) with standardized imaging and relatively high case numbers were chosen. These procedures along with results are demonstrated in Table 1.

Study limitations

Since we are primarily a teaching institution, it is likely that even without the use of CAREposition we might have observed a small reduction in screening times given increasing experience of both medical and allied staff. Also, despite the six month trial encompassing approximately 2,200 fluoroscopic/angiographic procedures, a greater period of data collection would have certainly provided more accurate results.

Discussion

[...] CAREposition appeared most beneficial in the scenario of sequential diagnostic imaging of peripheral vasculature, whereby accurate overlap between acquisitions could be achieved with minimal fluoroscopy. Aorto-femoral diagnostic angiographic studies saw a 7 % reduction in screening time (3:26 to 3:11 min), with single leg diagnostic studies demonstrating a 21 % reduction (1:30 to 1:11 min). A similar result was demonstrated for diagnostic AV fistulography, where a 26 % reduction (1:06 to 0:49 min) was observed. Several examples for procedures are listed in Table 2. When operators gain confidence in the



1 Utilization of CAREposition during three angiographic procedures:
a Trans-jugular liver biopsy
b Cerebral angiography
c Femoral angiography

accuracy of CAREposition functionality, huge reductions in screening time could be achieved. Such was highlighted when reliance exclusively on CAREposition for guidance of angiographic positioning in three peripheral diagnostic studies comprising 19 separate acquisitions, were achieved with totals of only 4, 6 and 8 seconds fluoroscopy time [...]
[...] screening times in interventional procedures are heavily dependent on both the patient pathology and the skill of the clinician. Although difficult to quantify, CAREposition appeared extremely useful in complex and challenging interventional procedures especially when multiple working projections were employed. In the angiographic intervention of AV fistulas only a small reduction (5 %) in screening time was demonstrated, however, noting our case numbers were small. A much larger result was demonstrated in jugular venoplasty procedures. This interventional procedure was chosen because it provided the largest subject group of all the interventional procedures and involved standardized imaging of both internal jugular veins and azygos system with subsequent angioplasty of stenosed vessels, providing us with a more accurate reflection of the benefits of CAREposition.

Conclusion

CAREposition provides radiation-free fluoroscopic and angiographic positioning with the use of graphic markers overlaid on the fluoroscopic last image hold. Our study has demonstrated that the utilization of CAREposition has resulted in a modest decrease in screening times for a range of diagnostic procedures with greatest benefit being demonstrated when used in sequential diagnostic imaging of peripheral vasculature.

Thanks to the following angiographers for their assistance in compiling procedural data: Jane Chow, Karen Patel, Alix Fell, Wayne Chan, Neal Russell, Lisa Broadley.

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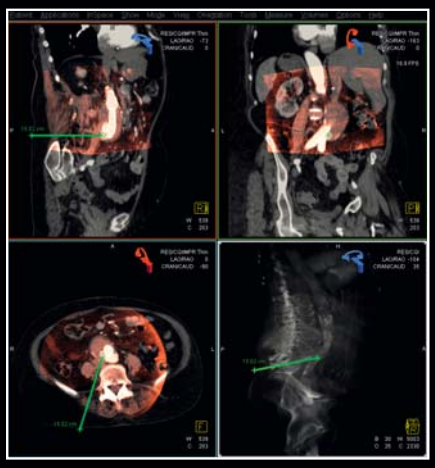
Endoleak Treatment: Enhanced Visualization Meets Enhanced Navigation

Diagnostic CT scan showes an Endoleak Type II.



The CT images are fused with the *syngo* DynaCT dataset.

syngo iGuide allows you to place target and skin entry point on the CT image, which is overlaid onto the *syngo* DynaCT.

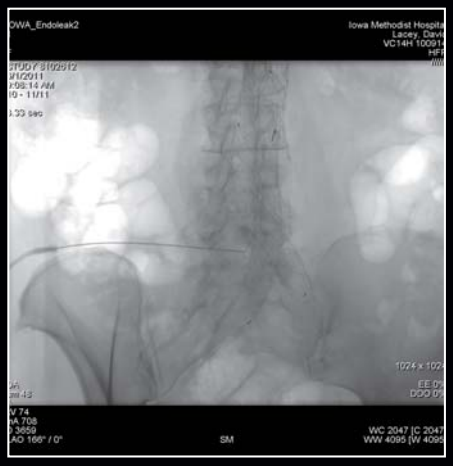
1 **2** **3**

syngo iGuide integrated needle guidance enables vascular surgeons and interventional radiologists to efficiently, precisely, and effectively treat type II endoleaks, one of the most vexing complications following endovascular abdominal aortic aneurysm repair.

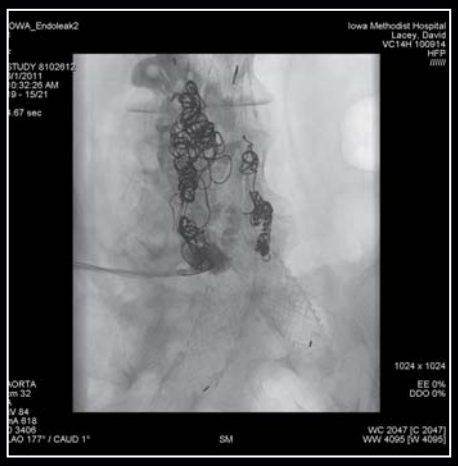
By Sameh Fahmy, MS

The endovascular repair of abdominal aortic aneurysms (EVAR) with stent grafts has surged in popularity over the past decade, dramatically reducing the amount of recovery time for patients in comparison with open repair. However, approximately one-third[1] of patients who undergo EVAR will have an endoleak, a condition in which blood flows outside the lumen of the endograft but within the aneurysm sac, potentially increasing the risk of rupture. In type II endoleaks, aortic branches that

syngo iGuide provides a bull's eye view and progression views for optimal needle tracking.



After reaching the target a catheter will be placed in the endoleak.



A DSA scene shows clearly all endoleak related vessels. The feeding vessels will be embolized with various coils and Cordis Trufill n-Butyl Cyanoacrylate glue.

4 **5** **6**

have been excluded by the endograft, such as the lumbar arteries and the inferior mesenteric artery, perfuse the aneurysm sac via retrograde blood flow. Type II endoleaks are the most common endoleak and can have multiple feeding and draining vessels that make their treatment challenging. "Sometimes when we get referred to these patients, they may have had three or four transfemoral attempts at blocking the endoleak off," says Alan Lumsden, MD, Medical Director of the Methodist Hospital DeBakey Heart and Vascular Center in Houston, Texas, USA, and Professor of Cardiovascular Surgery at Weill Cornell Medical College of Cornell University. In July 2010, Lumsden and his colleagues began using *syngo* iGuide integrated needle guidance, a software solution that enables physicians to perform needle procedures more precisely and efficiently using the Artis zee family of C-arm systems. Because the planning of the procedure is accomplished using cross-sectional images acquired with *syngo* DynaCT, the solution frees up the hospital's computed tomography (CT) scanners for routine diagnostic imaging and enhances workflow by eliminating the need to transfer the patient during the procedure. "The most important thing for us is that the aneurysm stops growing," says Lumsden, who uses the multi-axis Artis zeego. "And in the majority of patients that we have treated with *syngo* iGuide, the aneurysm has stopped growing and the endoleak has gone away."

"In the majority of patients that we have treated with *syngo* iGuide, the aneurysm has stopped growing and the endoleak has gone away."

Alan B. Lumsden, M.D., Medical Director Methodist DeBakey Heart and Vascular Center, The Methodist Hospital, Houston, TX, USA

Interventional radiologists such as David Lacey, MD, at Iowa Methodist Medical Center in Des Moines, Iowa report similar promising results. "I'm more apt to be able to select small vessels and embolize them, and our results have been very good," says Lacey, who in 2008 became one of the first users of *syngo* iGuide in the USA.

Saving Time and Streamlining Workflow

The two most common approaches for treating type II endoleaks are the transarterial approach, often via transfemoral access, and direct translumbar puncture. The success rate of the transarterial approach is low, with up to 80 percent recurrence rate due to the complexity of endoleaks and the potentially circuitous route.[2]

"The transfemoral approach has been tried and largely has failed," Lumsden says. "The idea behind the translumbar procedure is that instead of going through multiple feeding branches, you go right where they all come together and work into those feeding branches from inside that. The access in trying to go transfemoral or transmesenteric is very long and torturous; some catheters can't even get to them."

Lacey explains that before Iowa Methodist Medical Center began using *syngo* iGuide with its ceiling-mounted Artis zee, he and his colleagues would use a translumbar approach and advance the needle into the endoleak cavity using CT fluoroscopy. After confirming that the needle was in position by the pulsatile return of blood, the physicians would exchange the needle over a guidewire, secure the wire with tape, and then transfer the patient to the interventional radiology angio suite. The patient would then be re-prepped before physicians used the guidewire to advance a catheter under fluoroscopic guidance into the endoleak cavity, where coils and glue are used for the embolization. With the installation of *syngo* iGuide, however, the entire procedure is performed in the angio suite – and in a much shorter amount of time. Detailed anatomical information is obtained with *syngo* DynaCT, and the images are fused with a diagnostic CT that was obtained earlier. To define the needle path, physicians mark the needle target point in the CT dataset and then mark the location of the skin entry point. By scrolling through the multiplanar reformations, physicians can follow the needle path easily and verify that there are no vital structures, such as the inferior vena cava, in the way of the planned path. *syngo* iGuide automatically proposes two needle progression views, in which the planned path is graphically overlaid onto the fluoroscopic image. The needle is advanced under fluoro guidance, and an additional *syngo* DynaCT run is performed in slab mode to check the final position of the needle. Once the needle position is verified, the physicians perform the embolization.

Lacey estimates that the use of *syngo* iGuide reduces the time it takes to perform the procedure by an hour, while Lumsden notes that it may save even more time in particularly complicated cases. "The last one we did probably took an hour," Lumsden says. "Before, it probably took two to three hours."

In addition to the measurable reduction in time associated with the use of *syngo* iGuide, the elimination of patient transfer from the CT has the theoretical advantage of maintaining sterility, since physicians no longer have to transfer a patient with a wire extending from the aneurysm sac, out the patient's back, and to the outside world.

A CT scanner can be used for many diagnostic scans in the time it takes to complete a single needle procedure, so the elimination of the CT scanner for needle guidance also has clear financial benefits. Lacey points out that the increasing use of interventions such as CT biopsies and CT ablations has put additional scheduling demands on the scanners at Iowa Methodist Medical Center, making any technology that reduces demand for the CT scanners especially welcome.

"The 3D overlay lets you look at any angle to figure out how to best navigate the otherwise unpredictable pathway into this lesion."

David L. Lacey, M.D., Department of Radiology, Iowa Methodist Medical Center, Des Moines, Iowa, USA

Lacey points out several components of *syngo* iGuide that he says reflect a level of refinement not seen in similar needle guidance systems. The ability to obtain a control scan after the needle has been placed helps ensure accuracy by automatically correcting for patient motion or even the deformation of tissues caused by the pressure of the needle on the skin. The Artis zee ceiling-mounted system he uses is equipped with an integrated laser crosshair that precisely marks the skin entry point. This reduces radiation dose by eliminating the need for fluoroscopy to match the needle tip with the path in the bulls-eye view and improves ease of use. After acquiring the initial *syngo* DynaCT scan to define small structures, Lacey uses *syngo* DynaCT in low-dose mode to further minimize radiation to the patient.

Once the endoleak site has been accessed, Lacey uses an additional tool known as *syngo* iPilot to overlay a 3D *syngo* DynaCT angiography image on the live fluoro as he navigates the catheter. "The 3D overlay lets you look at any angle to figure out how to best navigate the otherwise unpredictable pathway into this lesion," Lacey says. "It allows you to very quickly and easily pick off the supplying vessels and really helps you address the full extent of the leak."

Handling Challenging Cases with Ease

Lumsden says that using conventional techniques, most physicians are quite happy just to get the needle into the aneurysm sac. The precision that *syngo* iGuide enables, however, allows physicians to enter the aneurysm sac at a location that maximizes their likelihood of embolizing the vessels that are feeding the endoleak.

"If you have two lumbar arteries that are feeding into the aneurysm and we enter right alongside one of them, we can't bend the catheters around to get to it," Lumsden explains. "So one of the things we're looking at is trying to choose the trajectory that will give us the best opportunity to catheterize and block off these feeding vessels."

The physicians say the power of the technology is evident by the ease with which it handles challenging cases. Lacey points out that he often encounters aneurysm sacs that measure less than a centimeter. The difficulty of accessing them is compounded in larger patients, who in many cases require a 20-centimeter needle. "That's a long way to go to get an accurate placement with a needle, but it turns out to be pretty easy to do with this system," he says. "I'm always impressed that I can hit that target, often in just one pass, using this system."

The physicians say that long-term follow-up and several additional cases will be required to quantify improved patient outcomes using *syngo* iGuide, but the early results are certainly promising. Lacey says the success in treating type II endoleaks at Iowa Methodist Medical Center has already led to referrals. In one recent case, the referring physician tried and failed to treat the patient using conventional tools and sent the patient to Iowa Methodist, nearly four hours away.

Lacey adds that *syngo* iGuide is so easy to use that it can give physicians who lack significant experience or confidence with needle procedures the ability to successfully perform procedures, including type II endoleak repairs, that they might otherwise find challenging. Using *syngo* iGuide is so simple, he says, "It's kind of like cheating."

Sameh Fahmy, MS, is an award-winning freelance medical and technology journalist based in Athens, Georgia, U.S.

1 Baum RA, et. al. Endoleaks after Endovascular Repair of Abdominal Aortic Aneurysms J Vasc Inerv Radiol 2003; 14:1111-1117

2 Baum et al. Treatment of type 2 endoleaks after endovascular repair of abdominal aortic aneurysms: comparison of transarterial and translumbar techniques. J VascSurg 2002; 35:23–29.

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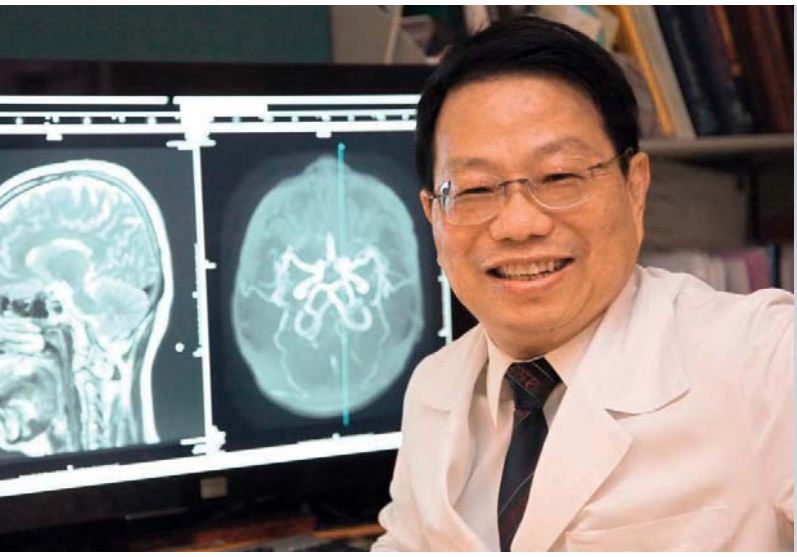
Quantitative Evidences of Hemodynamic Improvement of Brain Arteriovenous Malformation after Surgical Intervention Supported by Artis zee and *syngo* iFlow

Courtesy of Wan-Yuo Guo, M.D., Ph.D.
Department of Radiology, Taipei Veterans General Hospital, Taipei, Taiwan



Wan-Yuo Guo, M.D., practices in the Department of Radiology in the Taipei Veterans General Hospital.

Patient history

32-year-old female suffered from intermittent partial seizures with secondary tonic and clonic generalization for 5 years under regular medical treatment. The seizure frequency increased recently. The deteriorated seizure control brought the patient back to hospital to seek further treatment.

Diagnosis

Left cuneus region S-M grade II arteriovenous malformation (AVM).

Treatment

Craniotomy with surgical removal of the AVM was undertaken. The surgical course was uneventful. After surgery, no more seizures were noted during medical treatment.

Comments

DSA with *syngo* iFlow post-processing quantitatively illustrates the peri-surgical hemodynamic changes that related to the AVM. Before surgery (Fig. 1), TTP (time to peak opacification on DSA) of left PCA, the main feeding artery of AVM, is 2.83 seconds, which is shorter than the right PCA (3.83 seconds). The difference mainly results from the AV shunts that occur in the AVM, where a pressure gradient of blood flow is present. The gradient decreases the resistance in the artery and "steals" blood flow from the right side to the left PCA and makes the TTP of left PCA shorter. After surgical removal of the AVM (Fig. 2), the AV shunts are deleted and the pressure gradient is no longer present. No more blood flow is needed to compensate the pressure gradient. Equalization of TTP (3.13 seconds) is illustrated on left PCA and right PCA.

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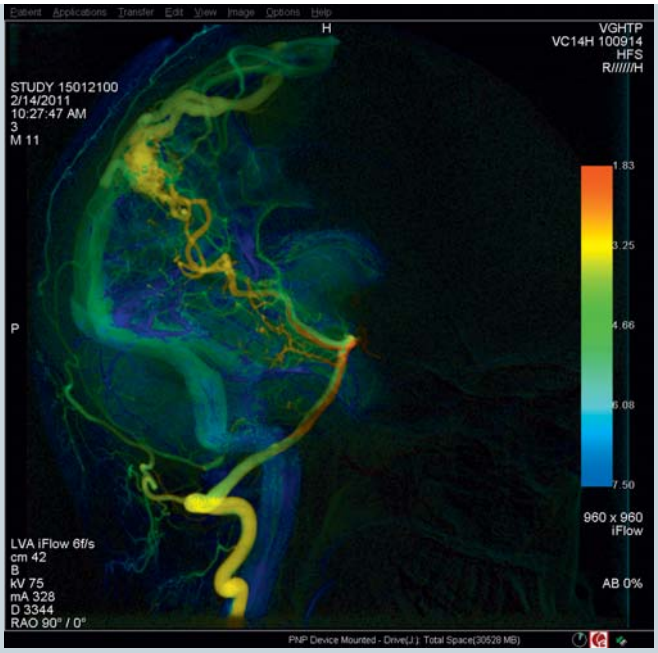
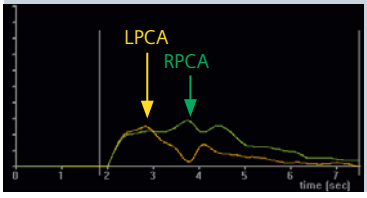
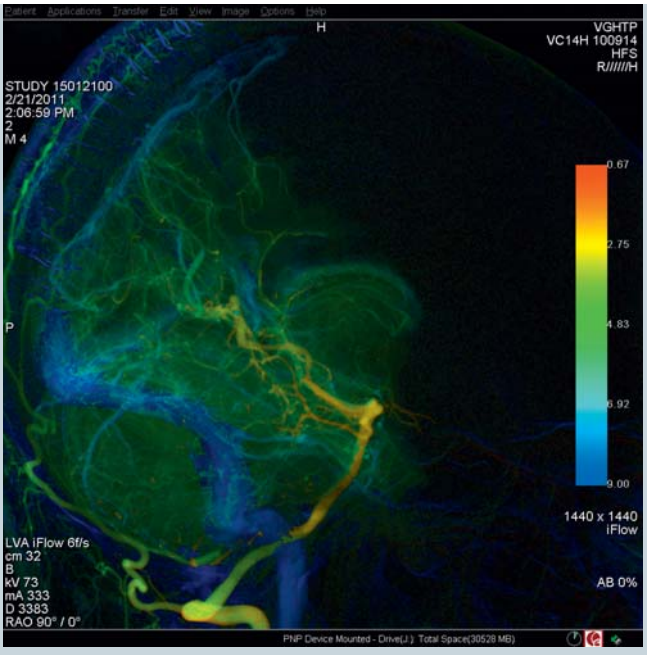
1

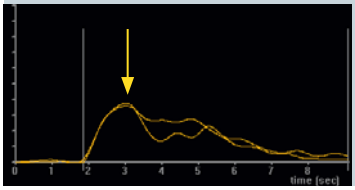




1 Before surgery, the TTP of the left PCA (the main feeding artery of AVM) is 2.83 seconds, which is shorter than the right PCA (3.83 seconds).

2





2 After surgical removal of the AVM, the AV shunt is deleted and the pressure gradient is no longer present. No more blood flow is needed to compensate the pressure gradient. The TTP of the left PCA and right PCA are equalized (3.13 seconds).

Revascularization Treatment of Acute Cerebral Stenosis Supported by intra-arterial *syngo* Neuro PBV IR

Courtesy of Qiang Zhang, M.D.
Department of Diagnostic Radiology, Military General Hospital of Beijing PLA, China

Qiang Zhang, M.D. is working with an Artis zeego system in his lab.

Patient history

A 47-year-old male patient with a 16-year history of hypertension and onset of diabetes mellitus 5 years ago presented with symptoms of paroxysmal numbness and weakness in his left extremities.

Diagnosis

Digital subtraction angiography (DSA) demonstrates a severe stenosis (80 %) in M1 segment of the right middle cerebral artery (MCA). A 3D intra-arterial *syngo* Neuro PBV IR examination was performed to examine the viability of the right brain parenchyma.

Treatment

A 2.5 x 9 mm intracranial stent (Apollo, MicroPort, China) was implanted at the position of stenosis through balloon dilatation. The procedure was performed under general anesthesia. DSA examination showed the morphological improvement of the M1 segment of the right MCA. The stenosis was reduced to less than 10 %.
After stenting, a *syngo* Neuro PBV IR run was performed by using the same acquisition and injection protocol as in diagnosis in order to quantitatively assess the quality of treatment. A significant improvement of the CBV value of the right brain hemisphere could be observed by the comparison pre- and post-stenting PBV imaging.

Comments

syngo Neuro PBV IR provides a mean to assess cerebral blood volume (CBV) in the catheter suite. It is a powerful and convenient tool to visualize the revascularization with cerebral ischemia directly before and after intervention. Different from the common *syngo* Neuro PBV IR examinations, in which an intra-venous injection protocol is used, in this case, a selective intra-arterial injection protocol was adopted. The pre- and post-treatment blood volume measurements were restricted to the right brain, the area that is supplied by the right common carotid artery. This way, the effect of revascularization on the right MCA could be best presented. More importantly, the usage of contrast agent in the intra-arterial injection was only 10 % of the amount used in intra-venous injection. Although this protocol has not been approved systematically, we believe that intra-arterial *syngo* Neuro PBV IR measurement could have a large application potential in conjunction with interventional treatment of cerebrovascular diseases. Ongoing studies are necessary to further approve the measurement with selective intra-arterial injection and to explore its clinical benefits.

Intra-arterial PBV Examination protocol

Imaging protocol	8s DSA
Contrast quantity	16 cc (350 mg/cc) diluted to 50 %
Injection rate	1 cc/s
Injection duration	16 s
X-ray delay	8 s
Injection site	right common carotid artery
Reconstruction preset	Neuro PBV

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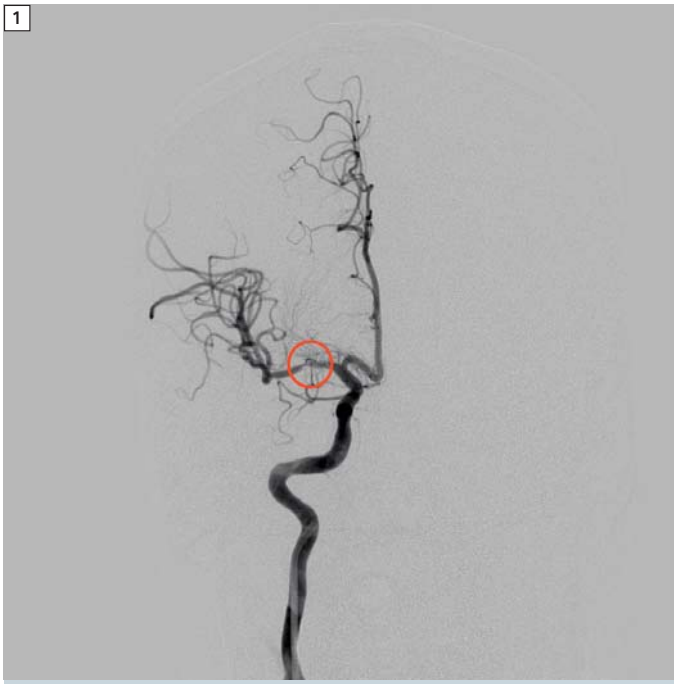
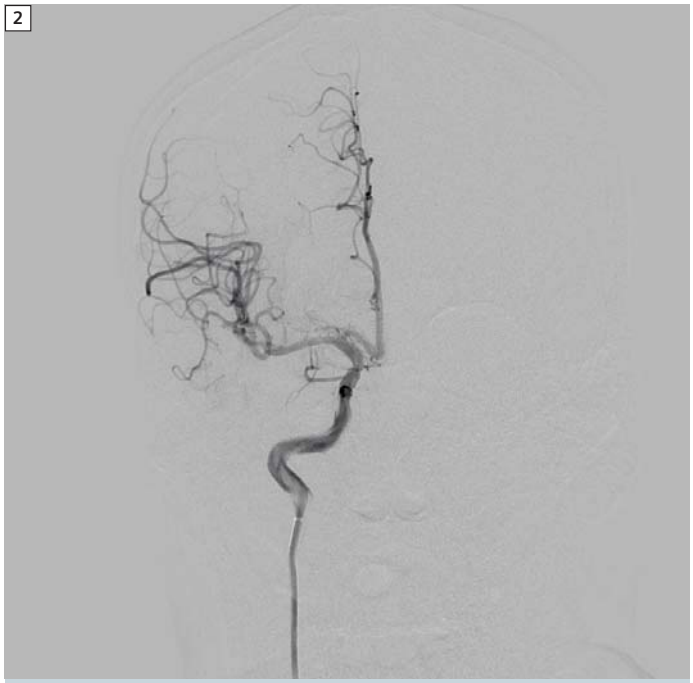
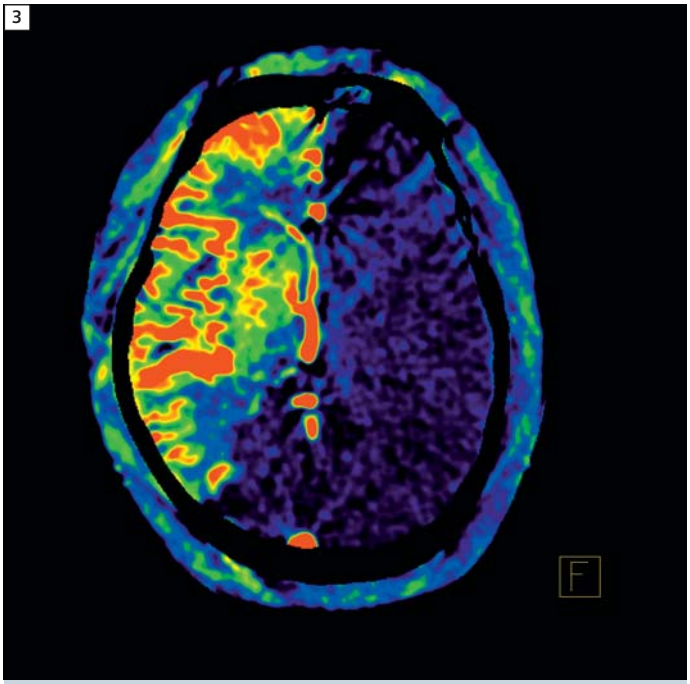


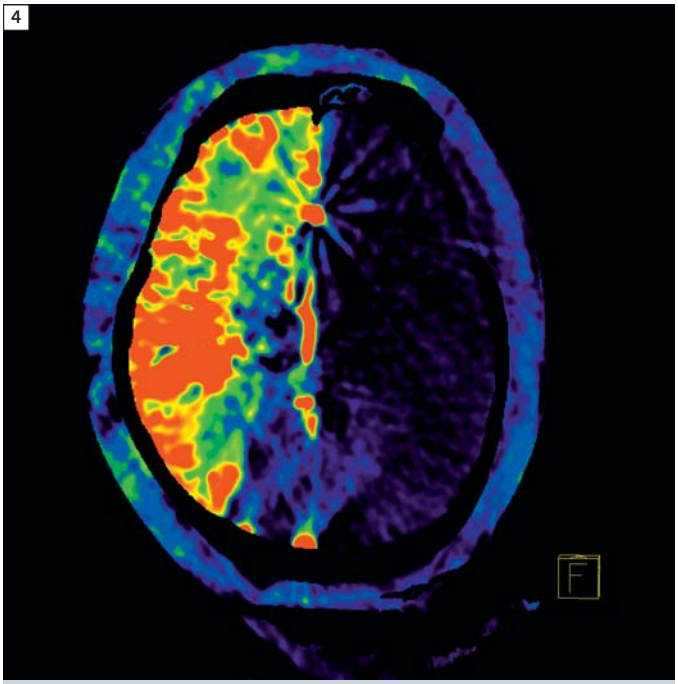
1 Pre-treatment: A severe stenosis in the M1 segment of the right MCA.



2 Post-treatment: Right intracranial vasculature was improved by stenting.



3 Pre-treatment *syngo* Neuro PBV imaging of the right brain hemisphere.



4 Post-treatment *syngo* Neuro PBV imaging of the right brain hemisphere.

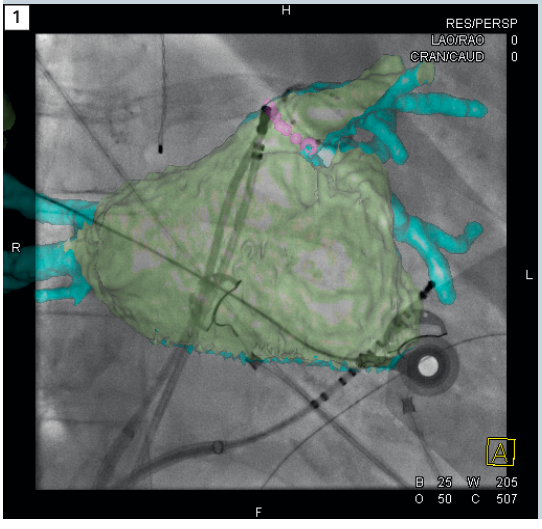
Overlay of MRI Images in Pulmonary Vein Isolation

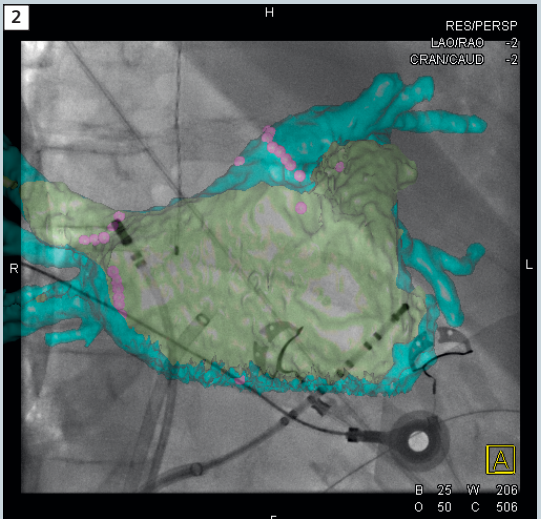
MRI images help the electrophysiologist to understand the anatomy and plan the right ablation strategy for pulmonary vein isolations. The 3D image is superimposed onto the live fluoroscopy und improves the guidance of the catheter during ablation therapy in the EP lab.

By Professor Rukshen Weerasooriya

Radio-frequency (RF) catheter ablation of atrial fibrillation (AF) is highly dependent on an understanding of the complex and variable anatomy of the pulmonary vein (PV) – left atrial (LA) junction. While CT 3D fluoroscopic overlay technique has been previously described, we have investigated the use of magnetic resonance (MRI) image fluoroscopic overlay (with *syngo* iPilot) which has the distinct advantage of lower exposure to ionizing radiation.

Figure 1 demonstrates the antero-posterior view of the position of the circumferential mapping catheter and the ablation catheter in the left superior pulmonary vein. The fluoro overlay involves a surface model generated using *syngo* InSpace EP and *syngo* iPilot. Figure 2, on the other hand, offers a view onto the right pulmonary veins. A decapolar catheter has been placed within the coronary sinus via a long curved sheath and an esophageal temperature probe is also present. Using this technology, major aspects of anatomy such as the intervenous ridges, venous calibre, early branching, accessory veins, roof pouches and appendage position can be appreciated. The *syngo* InSpace EP software enables cross-sectional representation of the left atrial anatomy (Fig. 3); a type of "endoscopic" fluoro overlay view, as well as tagging of ablation points, shown as pink tags at the ostium of the





1 Automated coregistration of 3D MRI of LA and pulmonary veins. Intra-procedural overlay during PV RF ablation.

2 Position marker of ablated region on MRI-based overlay during ablation of right inferior pulmonary vein.

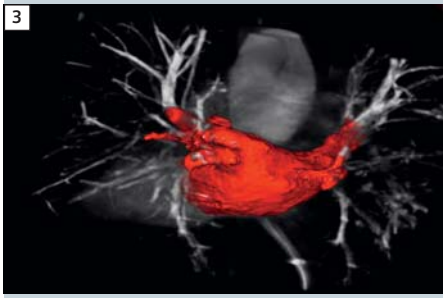
Prof. Weerasooriya, M.D. surrounded by his team.

"The ability to leave tags at ablation sites gives us confidence.
The clear demonstration of anatomical variants of the pulmonary veins is really important as there is no such thing as normal left atrial anatomy – variation is the norm."

R. Weerasooriya M.D.,
Department of Cardiology,
Hollywood Private Hospital, Perth, Australia

pulmonary veins (Fig. 1 and 2).
The MR images were obtained using a Siemens 1.5T Avanto scanner. All sequences were acquired during a breath-hold of 15-20 seconds. An initial test bolus is given to assess transit time to the left atrium. Left atrial morphology was acquired after injection of 0.2 mmol/kg of gadolinium-diethylene triamine penta-acetic acid (injection rate 3-4 cc/sec) and appropriate time delay using a Flash 3D sequence with axial imaging and voxel size 1.0 x 0.8 x 1.0 mm; TR/TE 2.91/1.1 msec; flip angle 25 degrees; FoV 350 mm; matrix 224 x 448.
Prior to the ablation procedure, a low dose 5-second 3D rotational fluoroscopic imaging (*syngo* DynaCT) without contrast is performed with T6 to T9 in the field of image. Using *syngo* InSpace 3D/3D Fusion, the *syngo* DynaCT and MR data are displayed fused together. The bony landmarks of the vertebral column are used for alignment and registration of the MR data set to enable accurate image overlay. During the ablation, the segmented left atrium from the MRI is displayed superimposed on the live fluoro image using *syngo* iPilot. The MR-fluoro overlay image, derived from the MR data set, is updated in real time to match the position of the angiography system maintaining an accurate overlay. An internal view of the left atrium is obtained using clip planes. Ablation points can be recorded by placing a tag at the tip of the ablation catheter. The tags are shown as part of the MR fluoro overlay.
syngo InSpace 3D/3D Fusion, *syngo* InSpace EP, and *syngo* iPilot software have enabled rapid and efficient fusion of the MR and fluoroscopic images at Hollywood Private Hospital in Perth, Australia. Using this software, pulmonary vein isolation can be undertaken in a safe and effective manner. Studies are currently underway to carefully evaluate the success and complication rates as well as radiation dose using this novel technology further. Initial results of applying this new approach to MR-guided PV isolation on a group of 43 consecutive patients with symptomatic AF have allowed us to perform the entire procedure without an EP mapping system. Despite removing the dedicated electroanatomical mapping system, cases are performed with similar fluoro time, radiation dose to the patient, and procedure time, while the preparation time has been reduced. A further improvement is the marked dose reduction to the operator performing the case as the low dose 3D acquisition can be performed with clinical staff out of the room.

3



3 Automated 1-click segmentation of the left atrium during ablation preparation

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Accurate Placement of Aortic Valves Supported by *syngo* DynaCT Cardiac

Walters DL, M.D.[1], Crowhurst J., Chief Radiographer[1], and Aroney C., M.D.[1,2]
[1] *Cardiology Department, Prince Charles Hospital, Brisbane, Qld., Australia*
[2] *Holy Spirit Northside Private Hospital, Chermside Qld., Australia*

"We found that the use of *syngo* DynaCT Cardiac significantly reduces the overall contrast volume and radiation dose required for the TAVR procedures. It accurately determines the choice of valve deployment position."

J. Crowhurst,Chief Radiographer, Department of Cardiology, Prince Charles Hospital Brisbane, Australia

The emerging technique of Transcatheter Aortic Valve Replacement (TAVR), is offering treatment options to many patients who are ineligible for open heart surgery due to frailty and other co-morbidities.
The success of this procedure is greatly dependent on the alignment of the valve prosthesis in the aortic root. The valve must be profiled perfectly perpendicular to the X-ray beam before deployment. This requires multiple aortograms being performed which is time-consuming, inaccurate and uses significant contrast media volumes. Performing a pre-operative or peri-operative CT scan can demonstrate the correct C-arm angle for placement of the valve. The cardiology team at the Prince Charles Hospital has compared the effectiveness of pre-operative CT against peri-operative C-arm CT for these procedures.

Method

Patients enrolled in the TAVI program were separated into two groups. One group was studied with pre-operative CT scans and the other underwent peri-operative C-arm CT (*syngo* DynaCT Cardiac). Predicted C-arm angulations from both groups were decided using Siemens *syngo* InSpace 3D software. In all cases, the Artis zee system was positioned using the CT scan's predicted angle. An aortogram was performed to confirm the accuracy of the predicted profile. Total contrast volume was noted for the re-valving procedure including contrast required for the *syngo* DynaCT Cardiac.

Comments

In the pre-operative CT group, the correct C-arm angulation was demonstrated in less than 30 % of cases, versus 93 % of cases where *syngo* DynaCT Cardiac was used to determine the angle. Initial findings show the average re-valving procedural contrast volume for the pre-operative CT group was 285 cc, versus 210 cc for the *syngo* DynaCT group. As a comparison over the combined CT + re-valving procedure, the total contrast volume for the pre-operative CT group was 335 cc, versus 210 cc for the *syngo* DynaCT group. Not only does the use of *syngo* DynaCT Cardiac result in the reduction of contrast required, it importantly also allows us to achieve a significant reduction in radiation dose. Indeed, through the entire assessment and intervention the amount of dose per patient was reduced on average from 255.5 CGy with a pre-procedural CT to 214.2 CGy when *syngo* DynaCT Cardiac is used instead.

Conclusion

The treatment with peri-operative C-arm CT with *syngo* DynaCT Cardiac significantly demonstrates a more precise angle of the C-arm when compared to traditional pre-operative CT. As the use of contrast media is critical for patients suffering from renal impairment, the use of *syngo* DynaCT Cardiac indicated to be the system of choice as less contrast media and radiation dose was delivered in comparison to pre-operative CT.

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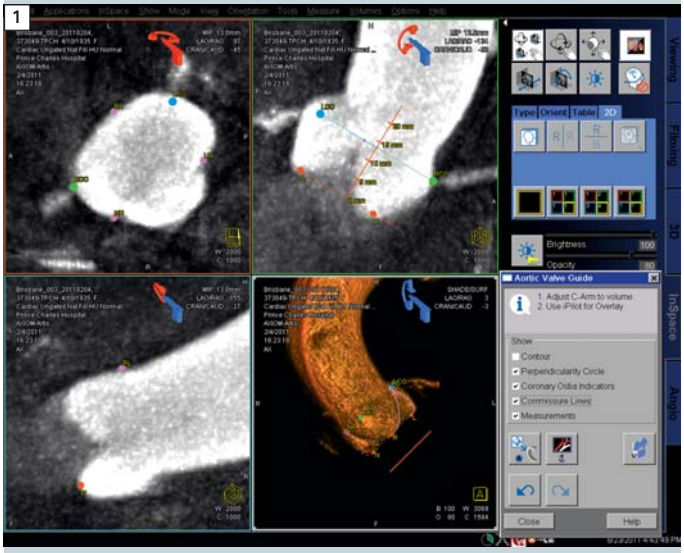
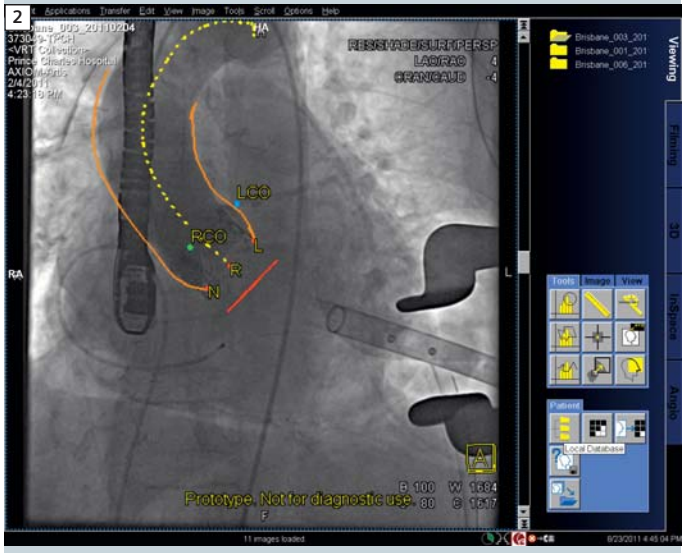
"Due to the increased accuracy of valve placement with *syngo* DynaCT Cardiac, this technique has become an integral part of all of the TAVI cases within our hospital."

Darren Walters, M.D., Director of Cardiology,
Prince Charles Hospital Brisbane, Australia



1 Aortic root segmentation result based on *syngo* DynaCT Cardiac 3D Volume.



2 Overlay of anatomical information and landmarks onto live fluoro for image guidance during valve positioning.

Minimally Invasive Aortic Valve Implantation Offers New Hope to Stenotic Patients

Since 2008, the Angiografia de Occidente cardiology group has performed 70 percutaneous aortic valve implantations. Siemens Artis zee imaging equipment is considered "indispensable" for the implants. In Europe, the procedure is rapidly becoming standard practice for elderly patients unsuitable for open-heart surgery.

by Chris Kraul

The city of Cali in southwestern Colombia might not leap to mind as a hotbed of cutting-edge medical technology, but Dr. Antonio Dager and his Angiografia de Occidente clinic are in the vanguard of nothing less than a revolution in minimally invasive cardiovascular procedures that is being helped along by Siemens Artis zee imaging systems. Since March 2008, Dager and his associates have performed 70 transfemoral aortic valve implants (TAVIs), more than any other clinic in South America. In all cases, Artis zee equipment was used to help diagnose the disease, usually aortic stenosis, and place the implants. Although not yet approved by the U.S. Food and Drug Administration, the relatively new procedure is rapidly becoming standard care in Europe, Canada, and Latin America for elderly stenotic patients with comorbidities who are not eligible for open-heart surgery because of their high-risk status.

Due to the relatively high volume of implants and Dager's success rate of 96 percent, his clinic was named in November 2010 to participate in a Medtronic-sponsored study of angioplasty centers worldwide that tracks the effectiveness of aortic valve implants. Medtronic is one of the principal manufacturers of the valves. The nine Siemens imaging systems that Dager's clinic uses are considered very helpful by the hospital for performing the 8,000 procedures – divided about evenly between diagnostic procedures and angioplasties – that Dager and three other interventional cardiologists at Angiografia de Occidente perform annually at seven locations in Cali, Popayan, and Pereira.

Essential for the 45-minute TAVI procedure is his Artis zee system, which is equipped with *syngo* DynaCT Cardiac for rotational angiography. It generates precise three-dimensional images that can be rotated, enabling him to see the aortic root from all angles. "It's better than life. It helps me pinpoint the exact place in the inferior portion of the aorta to align

the TAVI device. At first there was a lot of mispositioning, but with *syngo* DynaCT, results have improved significantly over the last three years," Dager said.
For pre-procedural TAVI planning Dager also makes use of computed tomography (CT). With the Siemens SOMATOM® Definition CT scanner he is able to precisely determine size, morphology and position of the diseased aortic valve. Furthermore the distance of the coronary ostia to the aortic annulus can be accurately assessed.

The way we have to see it

"Without this equipment, our work would be impossible. It can show with great definition the anatomy the way we have to see it," said Bernardo Caicedo, MD, Dager's partner at Angiografia de Occidente.
Adds Dager: "These systems are an extension of your senses, your mind, and your thoughts about the patient's condition. You can think out a case as you do the procedure, because the feedback and capture are instantaneous."
The systems also feature Siemens low-dose radiation technology that, for several reasons, makes the procedures significantly safer for patients and medical staff: Better images let Dager see organs and the progress of the guidewire more clearly, which reduces the time – and radiation – needed to make a diagnosis or place the implant. Advanced features like automated selection of filters, dose free repositioning of collimator blades and table as well as low dose acquisition protocols reduce the exposure. The upshot, says Angiografia de Occidente radiology technician Francisco Corredor, is that a typical angioplasty now requires significantly less radiation than a typical procedure a few years ago.
"Angiography systems used to disperse radiation indiscriminately in a cone-like path. Now, it is very targeted," says Dager. He speaks English with a faint Cajun accent, having spent some

> "Without this equipment, our work would be impossible. It can show with great definition the anatomy the way we have to see it."
>
> Bernardo Caicedo, M.D., Department of Cardiology, Angiographia de Occidente Clinic, Colombia

Dr. Dager plans the next steps during the treatment by checking the fluoroscopic image in the control room.

of his teenage years in New Orleans, where his father was Colombian consul. Dager's day starts at 7:30 a.m. and sometimes doesn't end until 10 p.m. if he has a "papa caliente" – Spanish for "hot potato", or emergency. On average, Dager performs ten diagnostic and interventional procedures per day, some lasting a few minutes, some up to three hours.

Among the 70 TAVIs he and his partners have done were eight U.S. patients who came to Dr. Dager's clinic in Cali at the insistence of cardiologists at the University of Miami Miller School of Medicine, with which Dager maintains close ties. The referrals usually come, he says, because the patients don't qualify for insurance reimbursement, and having the implant done at Angiografia de Occidente costs half as much as the cost of the procedure at a U.S. clinic.

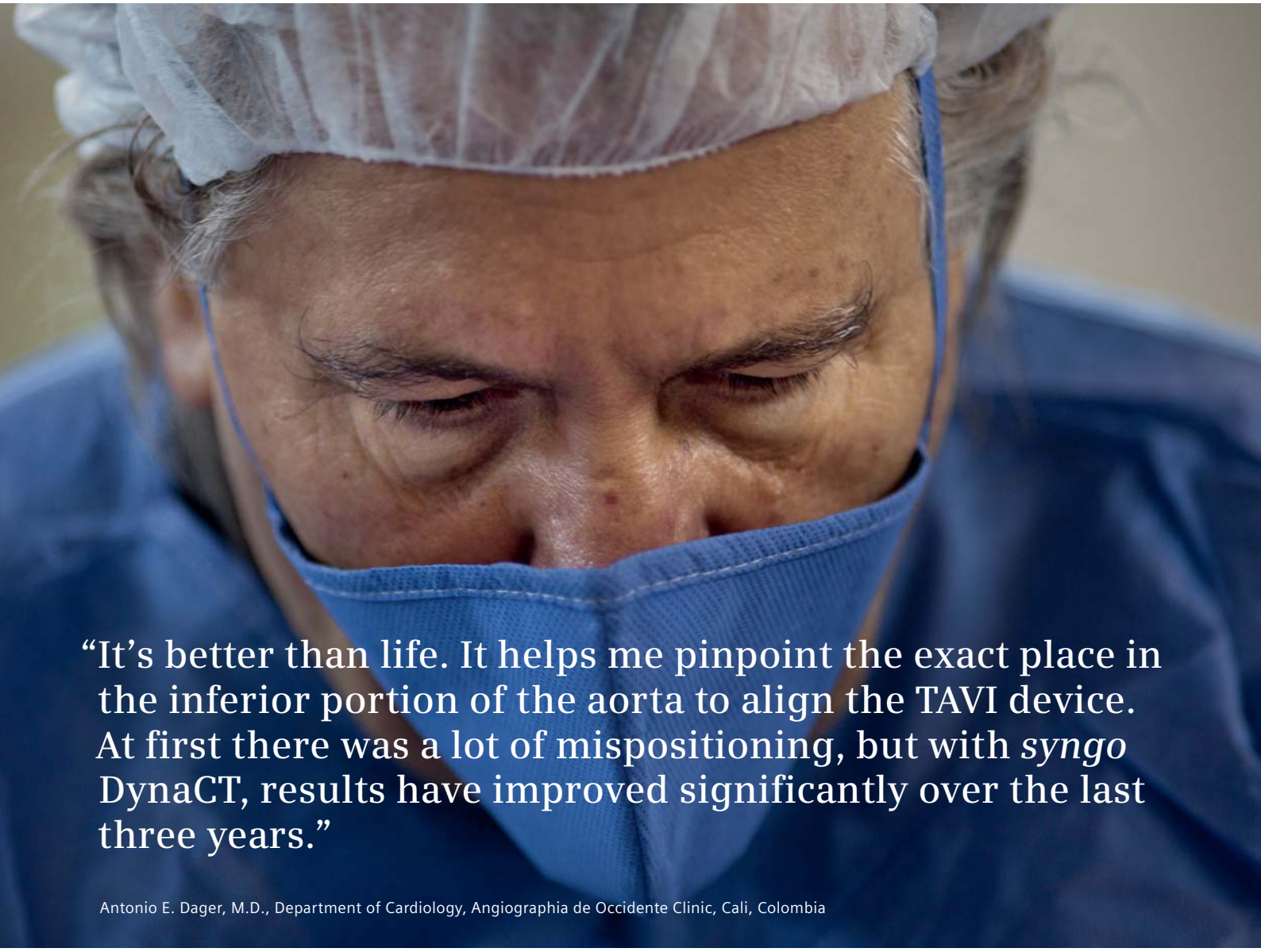
A dream come true

Dager's relations with the University of Miami medical school date from 1985, when he was accepted as a four-year cardiology and hemodynamics fellow under the school's William J Harrington Program for Latin American medical students and physicians. He cites the program as the source of much of his professional success and of his enduring passion for following the state-of-the-art in medical technology. By the time Dager began his fellowship in Miami, the Cartagena native had already spent a decade in general and intensive care practice in Cali after attending the Universidad del Valle medical school there. But he had always hoped to specialize in cardiology, particularly after a beloved uncle died of aortic stenosis in 1974, when the diagnosis was a virtual death sentence. The UM Harrington fellowship helped him realize his dream. Upon his return to Cali in 1989, he founded Angiografia de Occidente with Dr. Caicedo, a close friend who was his chief resident during his internship in 1974.

Better survival rates

Dager also gets referrals because the results of the TAVIs are so compelling. Patients in their 70s diagnosed with aortic stenosis who receive the implanted valve have a 77-percent likelihood of surviving the first year and a 69-percent chance of surviving two years, results that roughly track a Canadian study, Dager says. Those who do not receive implants have only a 50-percent survival rate one year after diagnosis and only 30-percent chances of survival after two years.

In their nearly four decades in medicine together, Drs. Dager and Caicedo say, they have witnessed a demographic shift in patient population due to Colombia's modernizing and urbanizing population. "We're in the midst of an epidemic in diet-related



"It's better than life. It helps me pinpoint the exact place in the inferior portion of the aorta to align the TAVI device. At first there was a lot of mispositioning, but with *syngo* DynaCT, results have improved significantly over the last three years."

Antonio E. Dager, M.D., Department of Cardiology, Angiographia de Occidente Clinic, Cali, Colombia

heart diseases. Lifestyles have changed from home cooking and daily siestas to more junk food and stress. As a result, we see lots more atherosclerotic and peripheral artery disease than we did 20 or 30 years ago. Stenoses get detected in patients' 40s and 50s instead of their 60s and 70s," says Dager.

Acceleration in procedures foreseen

That shift (which is in progress in varying degrees the world over), together with the growing success rate in TAVI procedures, is why experts are projecting a rapid acceleration in percutaneous aortic valve replacements in coming years. The procedures have already taken off in Europe, where more than 20,000 TAVIs have been performed up to now, up from only 1,000 in 2007, Dager says. He believes the need for aortic valve replacements will further increase, and possibly also among younger patients, who are more likely these days to receive implants via open-heart surgery.

Chris Kraul, a former foreign correspondent with the Los Angeles Times, is now a freelance writer based in Bogota, Colombia.

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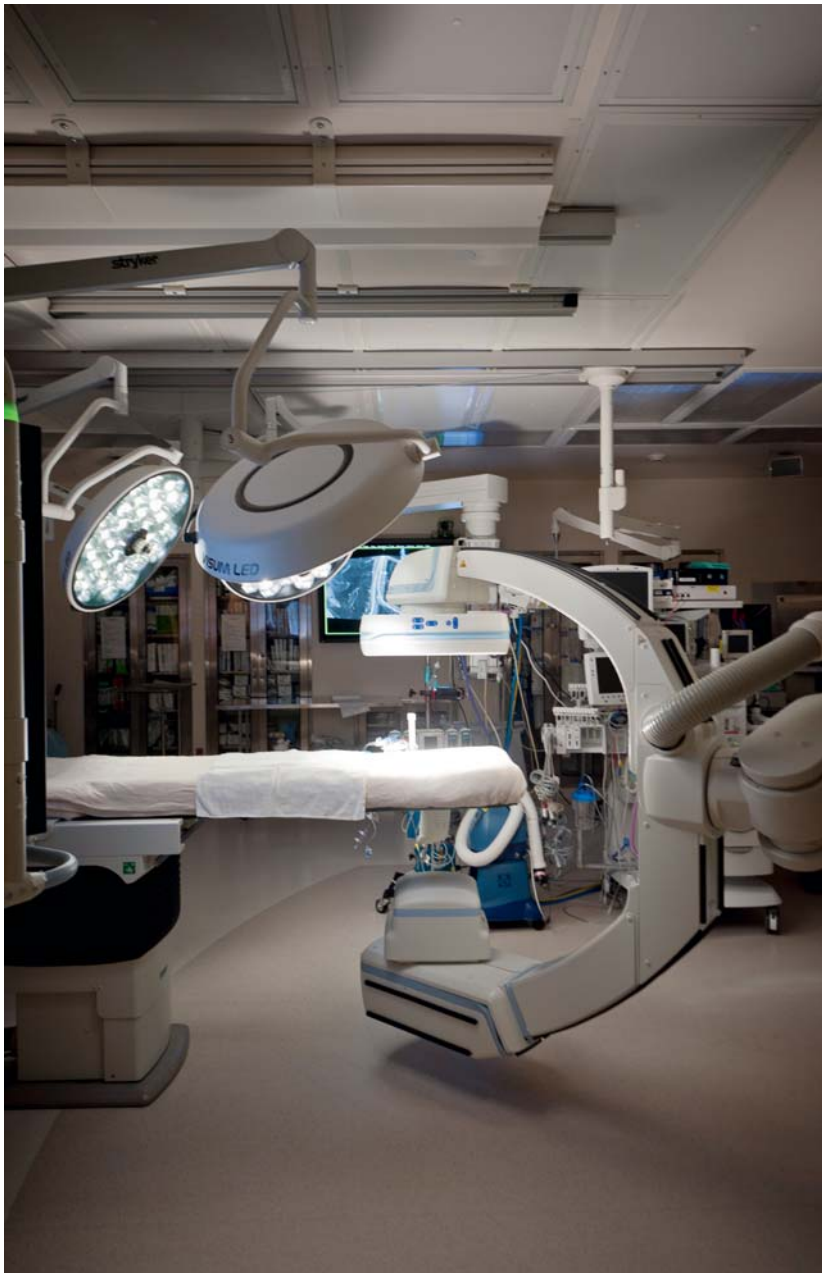
3D Imaging Brings a New Vision to Endovascular Surgery

Alan Lumsden, MD, a leader in the field of endovascular surgery, is Medical Director of the Methodist Hospital DeBakey Heart and Vascular Center Houston, Texas and Professor and Chairman of the Department of Cardiovascular Surgery at the Methodist Hospital, Houston, Texas. Lumsden, who has received more than $1.8 million in research funding and has contributed more than 300 papers to the medical literature, says 3D imaging in the operating room, robotic catheter guidance, and other advanced technologies have the potential to revolutionize endovascular surgery by improving accuracy as well as safety.

By Sameh Fahmy, MS

"We had angio suites, but we didn't have CT scanners in the angio suite until *syngo* DynaCT. Now we have a whole new set of imaging modalities that we can work from."

Alan B. Lumsden, M.D.,
Medical Director Methodist Hospital
DeBakey Heart and Vascular Center,
Houston, Texas, U.S.



A look into the new hybrid OR featuring Artis zeego.

Which early advances in imaging have been most consequential for surgeons?

The single most important piece of equipment was the portable C-arm. That has, in my opinion, transformed what we could do. No hospital is going to invest three or four million dollars in building a hybrid room before you had significant patient volume and reimbursement to justify building that. The next level really was fixed imaging suites in the operating rooms. Or I should also say, access to fixed imaging, because not all of them are in the operating room.

Tell me about some of the more recent milestones in imaging.

I think the next one is *syngo* DynaCT image fusion; that's the next revolution that's about to take place. We had angio suites, but we didn't have CT scanners in the angio suite until *syngo* DynaCT. Now we have a whole new set of imaging modalities that we can work from.

Can you give me an example in which *syngo* DynaCT is particularly beneficial?

Type II endoleak management is one example in vascular surgery. Another example would be for the thoracic surgeon. Rather than having a patient undergo a needle biopsy, and possibly bringing the patient back for a scope if the needle biopsy is non-diagnostic and then having a third procedure to resect the tumor, I think it could all be done in one shot. You could import the initial CT scan, fuse it on top of the patient, use something like *syngo* iGuide (integrated needle guidance), stick a needle in it for a biopsy, send it to the pathologist, keep the patient asleep, look at it. If it's non-diagnostic, we're going to stick a scope in there, take a biopsy, and send it to the pathologist. And if it's a lung cancer, it needs to be resected and it's going to happen right there. I think the technology is transformational.

How can 3D imaging aid procedural planning?

Let me give you a vision, although the pieces aren't all necessarily meshing together yet. One of the advantages of *syngo* DynaCT is 3D reconstruction, but we don't look at it in 3D. We have a 3D rendering on a 2D model. We would really like to be able to look at that 3D image and interact with it in 3D with tools that allow us to plan the operation. We would then push it to the simulators and practice on Mrs. Smith's renal artery angioplasty today. We could then take that same data set and push it to the Artis zeego tomorrow, fuse it on top of the patient and do the procedure having planned it three-dimensionally in a cave environment and having practiced on our simulator. Now you may not have to do this in every case, but it's the opportunity to do this on the more sophisticated cases that's significant. And the final part of this, and this is several years away, is using flexible

catheter robotics. Can we automate parts of this? Because that same centerline that we've used down the middle of the aorta to measure a length for an endograft could be a guide path for a robot. And that's not that far away. We have the catheter robots and are really interested in this interface between 3D navigation, which you can pinpoint with a robot, and the 3D imaging that Siemens provides.

What are some benefits of the robotic movement of the Artis zeego?
Right now, I think it's the ease of positioning the patient. But in the future it's going to be in the speed of the rotation of the image intensifier and detector, although I think that's going to have to be done under an IDE (investigational device exemption) with the FDA (U.S. Food and Drug Administration). The faster we can acquire the images, the fewer motion artifacts. It also may allow you to start measuring flow in vascular territories by looking at the speed in which they are being filled. So that's why the robotic component of the Artis zeego is pretty exciting. Right now we're really not using it to its maximal capability. A lot of these things are still under development.

How do the 3D imaging capabilities of *syngo* DynaCT improve your ability to treat patients in the hybrid suite?
I think it can improve accuracy. I'll give you an example of splenic and renal artery aneurysms. There was a patient recently whose CT scan I looked at in the office and it looked like this was a saccular aneurysm that was fairly easy to treat. When we did the 3D reconstruction and looked at it, there were actually several branches coming out of this aneurysm. It was marginal whether we should be treating it or not and we backed out of treating that patient because we thought the risk/benefit ratio was in favor of leaving it alone.

Tell me about the use of *syngo* DynaCT as a navigational aid.
With the catheter robotics that are currently available, we have highly accurate control and can move millimeter by millimeter when we need to. The first human cases have been done in relatively straightforward situations, the femoral artery, but the benefit really comes in some of the complex catheterization capabilities, so for example branched aortic endografts. One of the advantages perhaps of these robots is that when we've done the *syngo* DynaCT and we know the location of the renal artery is behind an endograft, where we can't inject it with dye directly, we can potentially with a robot puncture that endograft over the renal artery and then gain access to the renal artery. It adds a whole new conceptual capability in how we're going to manage those patients.

What are some advantages of combining 3D imaging with robotic catheter guidance?
Currently, when you take a catheter and navigate to the left coronary artery, you really don't navigate anything. You have a series of wall interactions between the catheter and the wall of the aorta all the way up – and that's where the complications come from. So centerline navigation is highly appealing. Can we get a catheter up there and never touch the wall or minimize wall contact? We may not be able to do it along the entire length, but in that critical terminal 10, 15 centimeters, can we build that capability? We can draw a centerline on *syngo* DynaCT, we can lay those lines on the patient so we can see a virtual line, and we're starting to have the ability to have that degree of accuracy in steering catheters. And those centerlines are just a series of points in space with coordinates – and robots follow directions pretty well.

What kind of training needs to be done for vascular surgeons to maximize the potential of 3D imaging?
When you see surgeons interacting with imaging equipment, it's not optimal. The radiation safety aspects basically are not there; the image optimization is often not where it should be. Those are gaps that we need to be teaching. I think there is an enormous imaging training opportunity, need actually, in the surgical world.

What do you see on the horizon for the future of imaging in surgery?
Right now, I think that you're beginning to see vascular surgeons using these tools and beginning to present and talk about them. But orthopedics, urology, general surgery, and thoracic surgery all have potential applications.

Sameh Fahmy, MS, is an award-winning freelance medical and technology journalist based in Athens, Georgia, U.S.

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Accuracy Far Beyond Conventional Pneumological Practice

Worldwide, cancer is a leading cause of death, with lung cancer causing more deaths than stomach, liver, colon and breast cancer. Taking biopsies from small lung nodules to diagnose cancer at an early stage poses an opportunity and a challenge at the same time. The smaller the nodule, the higher the survival rate of the patient, but the more difficult the biopsy. An efficient solution lies in guided navigation. With no artificial contrast medium but air the tumor is clearly visible with *syngo* DynaCT.

by Lena Schnabl

According to the WHO the lung tumor group is often diagnosed in the advanced stages, resulting in poor prognosis. However, a study from the American Cancer Society shows that if discovered early enough the overall survival rate is 88 %, making precautious, precise and reliable diagnosis essential. In June 2011 the National Lung Screening Trial (NLST) publicized its primary results. The trial was launched in 2002 and compared two ways of detecting lung cancer: low-dose helical computed tomography (CT) and standard chest X-ray. The primary results show a 20 % decrease in mortality from lung cancer in the low-dose CT group as compared to the radiography group. The rate of positive results was more than three times higher with low-dose CT screening than with radiographic screening.

A number of trials of low-dose CT screening are currently underway in Europe. More lung screenings will most likely result in more positive findings, such as the detection of a high number of small nodules that make clarification through biopsies necessary.
Taking biopsies from small lung nodules to diagnose cancer at an early stage poses an opportunity and a challenge at the same time. The smaller the nodule, the higher the survival rate of the patient, but the more difficult the biopsy. The likelihood of a lesion being malignant varies depending on age and smoking behavior as well as its size: As published in the 'Guidelines for Management of Small Pulmonary Nodules Detected on CT Scans', lesions measuring less than 4 millimeters found in low-risk individuals prove malignant in only one percent of cases. Those measuring 8 to 10 millimeters have a 10 to 20 percent chance of being malignant and 50 percent of lesions over 20 millimeters are cancerous, making clarification essential.

Challenge: Increase Accuracy of Tissue Samples

However, Schreiber found out that the accuracy of tissue samples taken from lesions of this size is relatively low: 33 percent in the case of lesions less than 20 mm as opposed to 62 percent for lesions over 20 millimeters. Small pulmonary nodules (SPN) tend to be benign rather than malignant, but they require more invasive treatment because conventional bronchoscopies on lesions of this size result in a low accuracy rate. Thus tissue samples can be false-negative. Dr. Wolfgang Hohenforst-Schmidt, Senior Physician at the Department of Cardiology, Angiology and Pneumology (Head of the Department Prof. Dr. Johannes Brachmann) at the Coburg Hospital in Germany says: "This poses a real problem. If the tissue sample proves to be malignant, I hit the lesion without doubt. But in the case of benign results the main question is, if I ought to believe these results. We urgently need an enhanced solution for the diagnostic clarification of small, peripherally located lung lesions in order to prevent false-negative results. This is only feasible via navigation." According to Hohenforst-Schmidt, the solution lies in guided navigation with *syngo* DynaCT. As the pulmonary medicine unit is located in the Department of Cardiology, Angiology and Pneumology the lung specialist has access to an angiography suite equipped with a

> "I believe hybrid rooms are the future of medicine. In such multi-level rooms, where angiography and surgery take place on the same table, cardiologists as well as pulmonologists, hepatologists and surgeons can gain from the benefits of intraprocedural imaging."
>
> Wolfgang Hohenforst-Schmidt, M.D., Department of Cardiology-Angiology-Pneumology, Klinikum Coburg, Coburg, Germany

ceiling-mounted angiography system. The *syngo* DynaCT application generates a CT-like dataset within a few seconds. Real-time fluoroscopic images are superimposed on this during the bronchoscopy, facilitating navigation within the bronchial tree. Hohenforst-Schmidt ensures that the diaphragm remains in a fixed position via jet ventilation during deep sedation. He uses no artificial contrast medium but air to make the tumor clearly visible with *syngo* DynaCT. According to the lung specialist, the major benefit of this approach is that it is a real-time procedure. Both stages – the acquisition of the *syngo* DynaCT dataset and the bronchoscopy under fluoroscopic guidance – are performed at the same time, in the same place and with the diaphragm in the same position.

"The increase in the hit rate to around two thirds poses a seismic shift."

To date, the lung specialist has taken biopsies from over forty patients via *syngo* DynaCT-guided bronchoscopies – with impressive results: During the proof-of-concept period the hit rate was 80 % in lesions with an average diameter of 24x23x23 mm, and 58 % in very small nodules with an average of 15x14x16 mm – only by forceps biopsies. "The increase in the hit rate to around two thirds poses a seismic shift", says the lung specialist, "But the problem of false-negative results is still conspicuous. To solve this, we want to bring additional instruments, such as needles, brushes, suction-cytology and 20-Mhz-miniprobes to the lesion in the near future. The expectation from other studies is that the additional use of these instruments will bring another 10 - 15 % of detection rate."
Hohenforst-Schmidt has also done several transthoracic biopsies using *syngo* DynaCT and *syngo* iGuide, the live and integrated needle guidance software. Tissue samples taken during transthoracic biopsies are usually bigger and therefore more accurate diagnosis is possible. *syngo* DynaCT enables the verification of the correct needle position and thus makes transthoracic needle procedures more effective.
Furthermore, the lung specialist has demonstrated that it is possible to dye small lesions so that they are more visible and easier to remove during subsequent surgical interventions. Additionally, Hohenforst-Schmidt believes *syngo* DynaCT can become a powerful tool to make progress in local ablative therapy modalities like radiofrequency ablation, microwave ablation, laser induced thermotherapy or intratumoral chemotherapy.: "Intratumoral chemotherapy can considerably extend the lifespan of patients and I am convinced that *syngo* DynaCT can contribute to doing so more precisely."
Other types of ablation, such as RFA, microwave and LITT or endoluminal brachytherapy also depend on exact navigation. Depending on the tumor size, these "total" local ablations are expedient in the context of a therapy using intratumoral chemotherapy, since affected lymph tracts and lymph nodes can absorb the outflowing chemotherapeutic agent in significantly higher concentrations than is the case with systemic administration. Undiscovered residual tumors in lymph tracts and lymph nodes are not reached by the local ablation, however, they are reached by intratumoral chemotherapy.

syngo DynaCT in the Hybrid Room

When asked which departments could benefit from angiographic imaging, the lung specialist answers that it is mainly suited to hospitals with a high patient circulation, in which at least 800-1,000 bronchoscopies are performed annually. "I believe hybrid rooms are the future of medicine. In such multi-level rooms, where angiography and surgery take place on the same table, cardiologists as well as pulmonologists, hepatologists and surgeons can gain from the benefits of intra-procedural imaging."

Lena Schnabl is a social scientist and works in the editorial team of Siemens healthcare communications. Among other topics, she writes about early detection and diagnostics of cancer on a regular basis

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Navigation in the Lung
Supported by *syngo* DynaCT Cardiac

Courtesy of Wolfgang Hohenforst-Schmidt , M.D.
Institute of Internal Medicine, Klinikum Coburg, Germany

"Local ablative therapies like intratumoral chemotherapy may considerably extend the lifespan of patients and I am convinced that *syngo* DynaCT can contribute to doing so more precisely in the future."

Wolfgang Hohenforst-Schmidt, M.D., Department of Cardiology-Angiology-Pneumology, Klinikum Coburg, Coburg, Germany

Patient History
A 70-year-old female.

Diagnosis
The patient was diagnosed with moderately differentiated lung adenomatous carcinoma four years ago and initially treated with chemotherapy. Currently the patient presents with multiple intrapulmonary nodules, metastases in the sternum and multiple osteoplastic metastases in the thoracic spine. Additionally the patient has cerebral metastases.
The patient was admitted for an update to diagnose the response to chemotherapy. In general the patient suffers from moderate dyspnea.

Treatment
A rapid data acquisition was performed with *syngo* DynaCT Cardiac under deep sedation and jet ventilation. In this intra-procedural 3D data set the tumor is clearly visible. Navigation through the bronchi is possible in different ways:

1 The 3D volume is overlaid with live fluoroscopy. This way, the physician can see live the movement of the biopsy forceps toward the tumor and make sure the biopsy captures the tissue (Fig. 1).

2 In addition to option 1, it is possible to manually mark a path through the bronchi as well as the volume of the tumor on the workstation. This path can then again be overlaid and followed when advancing the forceps to the tumor (Fig. 2).

3 Another option is to do a virtual bronchoscopy. The software currently allows navigation up to the 9th debranching of the bronchial tree (Fig. 3).

Comments
Intra-procedural 3D imaging of the bronchial tree with *syngo* DynaCT Cardiac together with the other software applications (*syngo* iPilot, *syngo* iGuide Toolbox and *syngo* FlyThrough) supports biopsies of even early-stage lung cancer. The open structure of the C-arm is well suited for interventions and proves to be useful in the field of pneumology.
The demonstrated case, shows that an overlay of the tumor in the 3D data set and the real-time fluoroscopy is very precise due to the fact that the whole procedure – 3D data acquisition and bronchoscopy – is done in the same suite at the same time and nearly in the same position of the diaphragm, guaranteed by the apnea under deep sedation (not general anesthesia) and jet ventilation.
We conclude that with *syngo* DynaCT Cardiac rapid onsite navigation in the lung could soon be a routine application in the bronchoscopy suite. *syngo* DynaCT Cardiac has the power to be the central part of a hybrid interventional pneumology / thoracic surgery suite.

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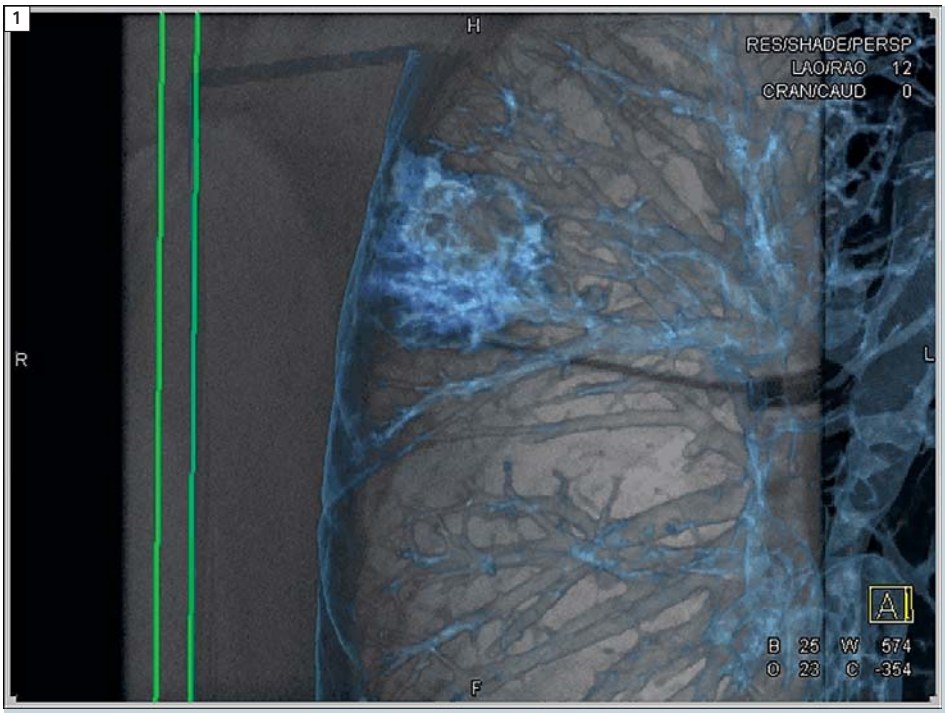
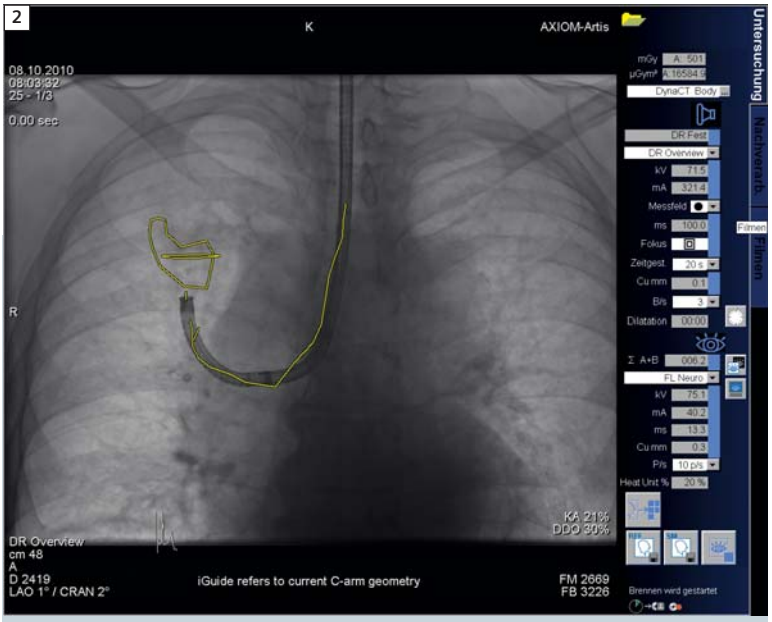
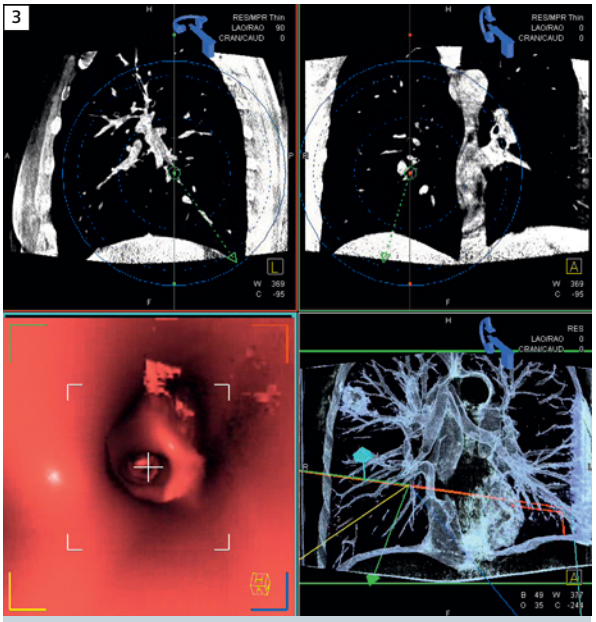


1 3D volume of the lung (*syngo* DynaCT Cardiac) with live fluoroscopy overlay (*syngo* iPilot).

Please note:
the clinical images are
from different cases.



2 Manually marked path (*syngo* iGuide Toolbox) through the bronchi and marked tumor volume.



3 Virtual bronchoscopy based on *syngo* FlyThrough.

Heart Valve Replacement – Significant Changes Thanks to Hybrid Surgery

Today, Japan's population is living longer than ever, but that also means a higher national incidence of elderly patients needing heart valve replacements. Siemens is collaborating with surgeons at Kurashiki Central Hospital to introduce lower-risk catheter-based procedures that eliminate the need for open-heart surgery in many of these cases.

By Clark Shimazu

Kurashiki Central Hospital is among three Japanese medical institutions whose multidisciplinary surgery teams conducted clinical trials of catheter-delivered Edwards prosthetic valves over the past year. The aim is to gain approval from the National Health Ministry for the innovative procedures. All of these institutions are equipped with Siemens hybrid rooms – a conventional OR equipped with an angiography system to allow for both open and minimally invasive treatment in one room. At Kurashiki Central Hospital, the room is equipped with a ceiling-mounted Artis zee angiography system from Siemens. The machine enables intra-procedural imaging in 2D and 3D and helps multifunctional teams of cardiac surgeons and cardiologists to best perform their procedures.

Doing heart valve replacements in a hybrid room is also recommended in a recent joint paper from the Society of Thoracic Surgeons (STS) and the American College of Cardiology (ACC), two of the most important cardiac surgical and cardiological societies in the world.

A multi-disciplinary team in a multi-disciplinary room

"The methods for implanting heart valves cannot be learned on one's own because close teamwork is essential among the different specialists, including interventional cardiologists, echocardiographers, imaging specialists and heart surgeons like myself," says Tatsuhiro Komiya, MD, Chief of the hospital's cardiovascular surgery department. "Since the launch of our joint program with Siemens in May 2010, each specialist has not only had to learn his own specific skills but also gain some familiarity with other team members' tasks, because we have to work in concert on the operation in a very short period of time."

The first round of clinical trials is especially important in Japan, where many elderly people among the aging population are outliving the normal duration of their heart valves. The aorta is the biggest artery in the body; therefore, its valve handles a larger flow than other heart valves. Seniors with a lot of co-morbidities, however, are not indicated to undergo open-heart surgery due to the risk that this procedure poses for them.

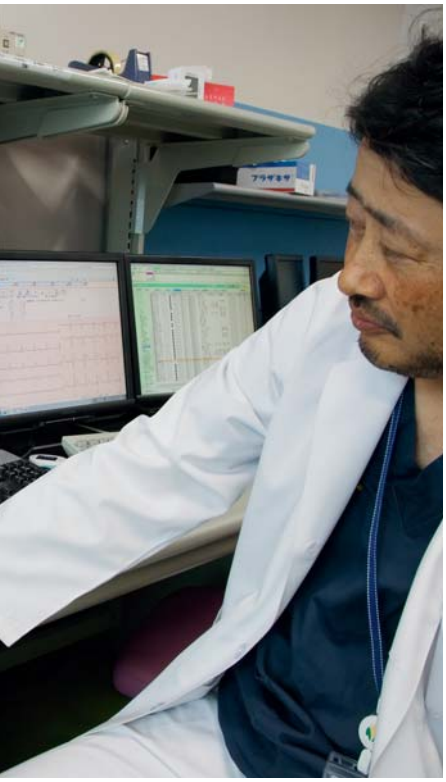
"For more than 30 years, we've relied on open-heart surgery, and that requires splitting the sternum," Komiya explained. "Many patients with defective heart valves are more than 70 years old. Among the national population, there are annually some 10,000 cases of degenerative disease in the aortic valve, but medical institutions must

turn away many prospective patients due to their advanced age and physical frailty. As a consequence, we can do only 70 open-heart surgeries a year at Kurashiki Central."

Catheter Delivery

The Kurashiki heart team is focusing on two different options for catheter-delivered replacements of the heart valves, transapical and transfemoral. The aortic valve from Edwards is replaced through a transapical insertion on a valve-mounted catheter, which is introduced through a surgical puncture into the apex of the left ventricle.
Produced by Edwards LifeSciences, based in Irvine, California, the prosthetic valves are based on an ingenious, yet simple design concept. They are bovine in origin and similar in size and shape to the natural valves in the human heart. These bio-valves are expandable wire-mesh stents which, when opened, hold the valve firmly in place. The Edwards valve does not require prior removal of the patient's own valve, but instead is slid inside the defective valve, permanently pushing back its leaflets and immediately taking over the function of maintaining one-way blood flow.
Catheter delivery minimizes or eliminates the need for open-heart surgery along with the trauma of opening large parts of the thorax. The patient also

Tatsuhiro Komiya M.D., Chief at the Cardiovascular Surgery Department of the Kurashiki Central Hospital, Kurashiki, Japan



Kurashiki Central Hospital is famous for its innovative procedures.

spends far less time in surgery, and there is no longer a need for external blood circulation with a cardiopulmonary bypass machine.
Navigation of an Edwards valve into the correct location demands orchestration of many components, including several high-tech imaging modalities, intensive planning and preparation, real-time monitoring, and multidisciplinary collaboration in ensemble.

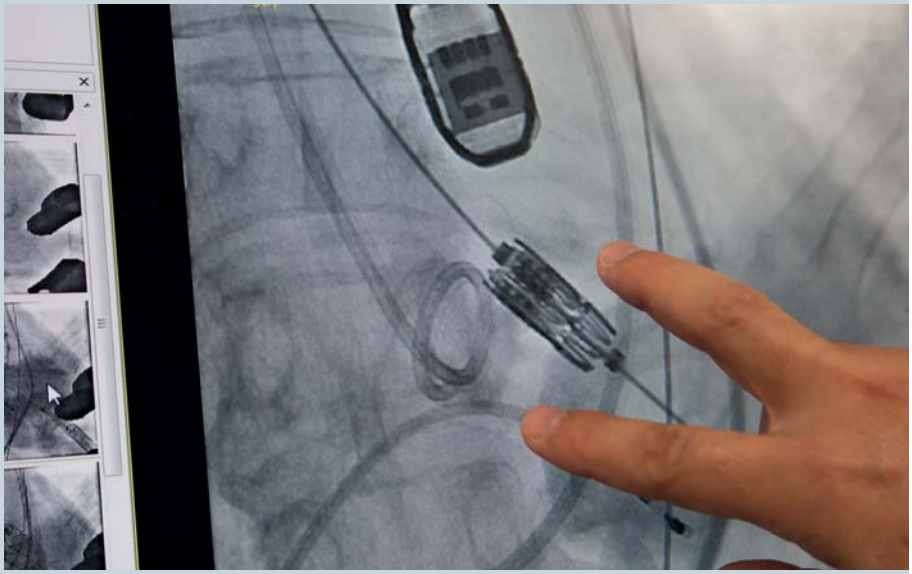
Taking a Balloon Ride

Komiya points out: "The single most important step is to align the valve ring on the aortic annulus between the left ventricle and the proximal ascending aorta. The valve must be precisely positioned on this line, neither too far in nor too short of the mark."
Echocardiograms, pre-operative CT and intra-operative *syngo* DynaCT images provide the heart team with a three-dimensional schema of the target region. The valve must also be perpendicular to the X-ray projection to capture the best real-time images of the catheter's progression.

The Edwards Sapien valve is compressed around a balloon catheter by a crimper to a diameter narrow enough to fit inside the patient's aortic valve. Meanwhile, the cardiac surgeon uses a scalpel to open an entry port between the two ribs directly above the apex. After completing the purse string sutures, the surgeon punctures the apical area for insertion of an introducer sheath. A temporary pacemaker lead is placed in the heart. The valve-bearing catheter is introduced through the sheath. Turning the control knob, the operator then maneuvers the flexible catheter, curving it toward and into the left ventricular outflow tract. After checking the alignment on screen the temporary pacemaker stimulates the left ventricle with up to 200 beats per minute. The heart contracts so rapidly that the cardiac output is minimized. The balloon swells to enlarge the stent, locking the bio-valve into place. The pacemaker is stopped; the balloon is deflated. The heart again pumps. The team watches to determine whether the Edwards valve is firm and functioning. The catheter and electrode wire are retracted. The surgeon then removes the introducer sheath to close the puncture in the heart.
"This, for me, is the most stressful moment, since any slip of the fingers could have catastrophic consequences," says Komiya. "The heart is beating while I close the thorax and skin incision." The multiplicity of tasks was done within a total span of just 12 to 14 minutes.

Positioning matters

"A vast amount of planning precedes the operation," Komiya states. "Echocardiograms and fluoroscopic images of each patient are examined from different angles so that the team can set the valve precisely into position."
If an aortic valve is positioned just millimeters off-center of the aortic annulus, a stent-in-stent procedure must be done, by slipping in a second wire-mesh ring to hold the first one firmly in place. "In one of our earlier operations, a valve was positioned slightly incorrectly," says Komiya. "Since we had doubts about its ability to maintain a grip, the team did a stent-in-stent insertion." That has held ever since, with no ill effects for the patient. "If a valve were ever to dislodge, that could be disastrous," he adds. "Our recourse then would be the immediate start of open-heart surgery." Which does not pose any technical problems - due to the fact that the operating room is a hybrid OR. The combined heart-valve unit provides quick backup in any unlikely event.
"Among our patients, in one case, a coronary was obstructed by the valve expansion, so we had to switch



Dr. Komiya explains the placement of the prosthetic heart valve.

immediately to open-heart surgery in our hybrid OR," Komiya discloses.

The aortic valve trials at Kurashiki Central have spurred development of valves of smaller diameter that are more suitable for Japanese patients who on average are smaller than European or American patients.

More extensive research and development on valve design must, of course, await ministry approval for the innovative valve replacement technique.

"Just like the American health system, the Japanese one demands comprehensive clinical trials on innovative procedures," Komiya says. "Our reporting of data must be quite rigorous to satisfy the strict requirements on testing medical claims."

Kurashiki Central and two other hospitals – in Osaka and Sakakibara – are now tracking the recuperation phase of some 50 patients who volunteered for the heart valve trials. Among this cohort, some received Medtronic's CoreValve, an aortic valve that is being implanted via the femoral arteries instead of the apex of the heart.

"The technique is rapidly developing, and Japanese patients and physicians are expressing enthusiasm," Komiya concludes. "This is a new frontier for medical science and surgical practice worldwide and here in Japan."

Clark Shimazu is an environmental and technology writer based in Chiang Mai, Thailand.

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An Innovative Setting – Hybrid Room 3D Imaging Delivers Groundbreaking Care

The hybrid operating room at St. Joseph Hospital in Orange County, California, USA, allows cardiologists and surgeons to transition seamlessly from minimally invasive to open-chest surgical procedures in the same environment. The interdisciplinary, multi-functional room maximizes patient care, improves overall outcomes and shortens hospital stays.

By Diana Smith

More and more hybrid rooms are installed in surgery departments. St. Joseph Hospital decided to go with the Artis zee system based on robotic technology.

In 2010, St. Joseph Hospital became one of the first facilities in the United States to unveil a hybrid operating room, used to treat heart and vascular disorders in adult and pediatric patients. The 525-bed hospital completes more than 7,000 cardiac and vascular procedures per year.

Located in densely populated Orange County, the facility is located in a state that has a significant elderly population, which is continuing to experience explosive growth. The California Department of Aging estimates that in 2010, one in five residents was 60 years of age or older. That number is expected to increase significantly – 38 percent in the next ten years*. As the hospital contemplated build-out of its operating room, evaluating volume and demographics, it became imperative to design a universal room that would be highly utilized and provide faster, better and more cost-effective care.

Today, in St. Joseph Hospital's fully equipped hybrid surgical suite, physicians perform open, minimally invasive, image-guided and/or catheter-based procedures, or a combination of procedures at the same time, in the same

operating room. The hybrid room incorporates groundbreaking three-dimensional technology, and is staffed by a specially trained team of nurses, radiological technicians and cardiovascular technicians.
For patients requiring complex procedures or for high-risk patients, such as those over age 80 with valve disease or those who have had multiple heart and vascular surgeries, the hybrid room is an optimal setting. Because of the high-resolution and highly accurate 3D imaging available in the hybrid room, many of these patients are able to undergo minimally invasive procedures, rather than major surgery, resulting in the highest degree of safety, improved recovery time, and less time in the hospital setting.

A New Level of Imaging

St. Joseph Hospital's hybrid operating room is equipped with a robotic, state-of-the-art imaging system, Artis zeego, which provides excellent image quality for interventional cardiology and cardiac surgery as well as flexible system positioning for anesthesiologists. The system has an unrestricted positioning ratio and acquires even three-dimensional images. The exceptional imaging technology allows physicians to perform the most complex adult and pediatric open heart surgeries as well as minimally invasive procedures. It is one of the few hybrid operating rooms in the country with this capability.
To enhance clinical decision-making in the hybrid OR, high-resolution, dynamic images of the heart and vascular system are created with Artis zeego and Siemens *syngo* DynaCT software, resulting in a highly accurate 3D model that can be rotated freely in space on the workstation. With the advanced technology, physicians can precisely assess and measure structural defects in the chambers, walls and valves of the heart as well as blockages in the major blood vessels and/or arteries.
The extreme level of accuracy helps reduce duration of procedure by simplifying navigation when treating defects in the heart or aneurysms of major blood vessels. As a result, many patients can be treated using minimally invasive procedures instead of open surgeries that would have previously been required. Additionally, physicians report that they are able to use significantly less contrast and take fewer images because the quality and clarity is exceptional. According to St. Joseph Hospital staff, imaging in 3D has resulted in improved outcomes, faster recovery times and less physical and emotional stress for patients and their families.

Multiple Capabilities, Increased Efficiency

St. Joseph Hospital chose the Artis zeego system for its exceptional technology, but the physicians and staff also enjoy the benefits of other features. Inspired by advances in automated manufacturing, the Artis zeego system can be positioned exactly the way it is needed and controlled with far greater ease and precision than traditional floor- or ceiling-mounted systems.
A major benefit of the system is its large volume cross-sectional imaging, with up to 47 cm in diameter offering broader coverage of the anatomy. Additionally, clinicians in the hybrid room can adjust the working height of the system, therefore reducing fatigue and backache associated with fixed heights, heavy lead aprons and lengthy procedure times, an especially important factor when repairs can stretch into multiple hours.
While the hybrid room is the most technologically advanced operating environment, it has also been a model for maximum efficiency and clinical workflow. Because it is set up for all kinds of patients, the hybrid room has a high utilization rate, optimizing efficiency and workflow. The room is scheduled every day and used for all types of vascular and cardiac procedures, including percutaneous pulmonary artery valve (Melody™ valve) insertion, plus overflow from the catheterization labs, and even STEMI (ST-segment elevation myocardial infarction) patients.

Diana Smith is a freelance writer specializing in medical topics. She is based in Liberty Hill, Texas, USA.

* Source: California Dept. of Aging, www.aging.ca.gov/stats/oldest_old_population.asp

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Leipzig – Dallas	Leipzig, Germany	International Live Case Meeting	Dec 1 - 3	www.ltcs-leipzig.com/
LINC Houston	Houston, Texas, USA	Live Interventional Neurology Conference	Dec 5 - 8	www.linchouston.com
Boston AF	Boston, USA	Annual International Boston Atrial Fibrillation Symposium	Jan 12 - 14	www.afsymposium.com/
AsiaPCR/SingLI-VE	Singapore	International Symposium	Jan 12 - 14	www.asiapcr.com/
Arab Health	Dubai, UAE	Healthcare Exhibition & Congress	Jan 23 - 26	www.arabhealthonline.com/
LINC Leipzig	Leipzig	Live Course, The Leipzig Interventional Course	Jan 25 - 28	www.leipzig-interventional-course.de
STS	Fort Lauderdale, USA	Annual Meeting, The Society of Thoracic Surgeons	Jan 30 - Feb 1	www.sts.org/education-meetings/sts-annual-meeting
DGHTG	Freiburg, Germany	Annual Conference, German Society for Thoracic and Cardiovascular Surgery	Feb 12 - 15	www.dgthg.de
EAU	Paris, France	Annual Congress, European Association of Urology	Feb 24 - 28	www.eauparis2012.org
ECR	Vienna, Austria	Annual Meeting, European Society of Radiology	Mar 1 - 5	www.myesr.org
ASCVTS	Bali, Indonesia	Annual Meeting, Asian Society for Cardiovascular and Thoracic Surgery	Mar 8 - 11	www.ascvtsbali2012.org
CIT	Beijing, China	China Interventional Therapeutics Conference	Mar 15 - 18	www.citmd.com
SIR	San Francisco, USA	Annual Scientific Meeting, Society of Interventional Radiology	Mar 24 - 29	www.sirmeeting.org
ACC	Chicago, USA	Annual Scientific Session & Expo, American College of Cardiology	Mar 24 - 27	www.acc.org
DGK	Mannheim, Germany	Annual Conference, Deutsche Gesellschaft für Kardiologie -Herz- und Kreislaufforschung e.V.	Apr 11 - 14	www.dgk.org

Title	Location	Short Description	Date	Contact
Charing Cross	London, UK	Vascular & Endovascular Consensus Update	Apr 14 - 17	www.cxsymposium.com
AANS	Miami, USA	Annual Meeting, American Association of Neurological Surgeons	Apr 14 - 18	www.aans.org
CMEF	Shenzhen, China	China International Medical Equipment Fair	Apr 16 - 20	en.cmef.com.cn
TCTAP	Seoul, South Korea	Angioplasty Summit, Transcatheter Cardiovascular Therapeutics Asia Pacific	Apr 25 - 27	www.summit-tctap.com
ECIO	Florence, Italy	Conference on Interventional Oncology (Organized by CIRSE)	Apr 25 - 28	www.ecio2012.org/
AATS	San Francisco, USA	Annual Meeting, American Association for Thoracic Surgery	Apr 28 - May 2	www.aats.org/
GEST	New York, USA	Global Embolization Symposium and Technologies	May 3 - 6	www.gestweb.org
HRS	Boston, USA	Annual Scientific Sessions, Heart Rhythm Society	May 9 - 12	www.hrsonline.org
Africa Health	Johannesburg, South Africa	Healthcare Exhibition & Congress	May 14 - 16	www.africahealthexhibition.com
EuroPCR	Paris, France	Cardiovascular Course	May 15 - 18	www.europcr.com
Deutscher Röntgenkongress	Hamburg, Germany	Congress, Deutsche Röntgengesellschaft	May 16 - 19	www.roentgenkongress.de
AEPC	Istanbul, Turkey	Annual Meeting, Association for European Paediatric and Congenital Cardiology	May 23 - 26	www.aepc2012.org/index.php
SPINEWEEK	Amsterdam, Netherlands	International Congress, organized by several spine associations	May 28 - June 1	spineweek2012.com/
SVS	Washington, USA	Vascular Annual Meeting, Society for Vascular Surgery	June 7 - 9	www.vascularweb.org
ESTS	Essen, Germany	European Conference, European Society of Thoracic Surgeons	June 10 - 13	www.ests.org
Cardiostim	Nice, France	WORLD CONGRESS Cardiac Electrophysiology & Cardiac Techniques	June 13 - 16	www.cardiostim.com
WCIO	Chicago, USA	World Conference on Interventional Oncology	June 14 - 17	wcio2012.com
UKRC	Manchester, UK	UK Radiological Congress	Jun 25 - 27	www.ukrc.org.uk
ESC	Munich, Germany	Annual Congress, European Society of Cardiology	Aug 25 - 29	www.escardio.org
AOCR	Sydney, Australia	Annual Congress, Asian Oceanian Society of Radiology	Aug 30 - Sept 2	www.aocr2012.com
CIRSE	Lisbon, Portugal	Annual Congress, Cardiovascular and Interventional Radiological Society of Europe	Sept 15 - 19	www.cirse.org

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